Financial Impacts on Home Buyers of Mandated Energy Efficiency Improvements in Water Heating for State Affordable Housing Projects

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Executive Summary

This report argues that solar and heat pump water heating systems are affordable to buy when they are installed in new residential construction and their costs are included in home mortgage loans. For solar systems, the Federal Housing Administration (FHA) now permits Hawaii's lending institutions to increase a home buyer's qualifying ratios (the house-payment-to-income ratio and the total-debt-to-income ratio) by one percent, whenever the buyer purchases a newly constructed home with a federally approved solar water heating system. These "stretched ratios", available through FHA's energy-efficient mortgage program, recognize that utility bill savings from solar water heaters are substantial and can offset higher mortgage payments to pay for these systems.

The report also contends that solar and heat pump water heaters return positive "dividends" during home ownership, because their benefits exceed their costs. In addition to saving money on utility bills, these systems enable homeowners to claim income tax credits under Act 319, *Session Laws of Hawaii*, 1990. This Act provides income tax credits up to 35 percent of the cost of solar water heating systems and up to 20 percent of the cost of heat pump water heaters.

Act 255, *Session Laws of Hawaii*, 1992, requires the state Housing Finance and Development Corporation (HFDC) to install solar water heating systems in specified percentages of the total number of housing units in future residential projects that it approves between 1993 and 1995, and alternate water heating systems in the balance of these units.

This report describes a case study of the financial impacts on families of Acts 255 and 319. This study addresses two questions:

1. How much additional family income will be needed to qualify for the larger mortgage on a new house with an energy improvement, compared to an identical house without it, given that a major portion of the improvement's cost is included in the mortgage loan?

2. What will be the net effect on the family's pocketbook of all cash gains and losses associated with an energy improvement after two- and five-year periods of home ownership?

Since Act 255 applies to state housing projects approved between 1993 and 1995, the actual financial impacts on families of these two laws will depend on economic factors and conditions that are in effect during that period and beyond. Forecasts of these factors and conditions are difficult to make and beyond the scope of this study. Hence, the study took a retrospective approach and used counterfactual analysis to estimate financial impacts. Specifically, the study focused on families that bought homes in either 1990 or 1991 in Kumu Iki Village of the Villages of Kapolei, one of the state's affordable housing projects on Oahu's Ewa Plain. Since Act 255 did not require the state to install energy efficiency improvements in Kumu Iki Village, the report addresses the following question: What would have been the financial impacts on families now living in Kumu Iki Village, if the requirements of Act 255 had been in effect for that project?

The study shows that, if solar water heaters had been installed in Kumu Iki Village, then buyers of its "affordable" homes would have needed at most $264 of additional annual income to qualify for the larger energy-efficient mortgages needed to pay for solar improvements. Moreover, the additional annual incomes required for standard mortgages on homes with other types of energy improvements would be comparable to or greater than the additional incomes required for energy-efficient mortgages on solar homes.

The study also shows that families with "affordable" solar homes would have realized substantial net cash gains after either two or five years of home ownership. Cash gains would have ranged from $1,248 to $1,577, if the home was owned for two years, and from $961 to $1,836, if it was owned for five years. These cash gains occur because the benefits of these systems exceed their costs. Cash gains vary depending upon assumptions about utility rates, levels of home energy consumption, mortgage financing rates, and the homeowner's tax bracket.

Based on this study, the report recommends that the state inform home builders, real estate brokers, lenders and home buyers about state energy income tax credits and FHA's energy-efficient mortgage program. It also recommends that state energy and housing officials urge conventional mortgage underwriters (i.e., Fannie Mae and Freddie Mac) to adopt FHA's policy and grant a one percent increase in qualifying ratios for buyers who purchase solar homes.

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Introduction

Solar and heat pump water heating systems, and high-efficiency gas and electric water heaters are more expensive to buy than standard water heaters. So builders of tract housing ordinarily do not install these energy-efficient systems in new homes. When making home improvements, homeowners normally prefer that the simple pay-back periods of these systems not exceed the expected remaining period of home ownership. When these systems are compared to standard water heaters, the simple pay-back period is the elapsed time to pay off the initial cost of these systems from their accumulated utility bill savings less any operating expenses.[1] Acceptable pay-back periods are in the range of two to three years. Homeowners must also consider whether they can handle the overall cash flow requirements of these systems.

This report argues that solar and heat pump water heating systems are affordable to buy when they are installed in new residential construction and their costs are included in home mortgage loans. For solar systems, the Federal Housing Administration (FHA) now permits Hawaii's lending institutions to increase a home buyer's qualifying ratios (the

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1 Sydney Reiter, *The Financial Evaluation of Energy Costs and Projects,* Van Nostrand Reinhold Co., New York, 1985, p. 119.

house-payment-to-income ratio and the total-debt-to-income ratio) by one percent, whenever the buyer purchases a newly constructed home with a federally approved solar water heating system. These "stretched ratios", available through FHA's energy-efficient mortgage program, recognize that utility bill savings from solar water heaters are substantial and can offset higher mortgage payments to pay for these systems.

The report also contends that solar and heat pump water heaters return positive "dividends" during home ownership, because their benefits exceed their costs. In addition to saving money on utility bills, these systems enable homeowners to claim income tax credits under Act 319, *Session Laws of Hawaii*, 1990. This Act increased income tax credits from 15 to 35 percent of the cost of solar water heating systems and from 15 to 20 percent of the cost of heat pump water heaters.

This chapter discusses some of Hawaii's housing and energy problems and the state's response to these problems. Chapter II describes and evaluates various energy-efficient mortgage programs available from lending institutions. Chapter III presents a case study of the expected financial impacts on home buyers in state housing projects that have been mandated by Act 255, *Session Laws of Hawaii*, 1992, to have energy efficiency improvements in water heating. The study assumes that these buyers will use energy-efficient mortgages for solar improvements and will take advantage of the state's energy income tax credits.

A. Hawaii's Housing and Energy Problems

An affordable home has become an elusive dream for many of Hawaii's younger families. On Oahu, where 76 percent of the state's population reside, the median price, single-family home for sale during the second quarter of 1990 was $345,000, which was twice its value of $172,000 in 1987.[2,3] That home was affordable to families who earn $100,000 or more a year and who already have substantial equity in existing homes to make large down payments. Families with such incomes account for the top 5 to 10 percent of Oahu's family income distribution. Owner-occupied housing units accounted for just 41.6 percent of Hawaii's total housing inventory in 1989.[4] Not surprisingly, nearly half of 800 adults polled in late July and early August 1990 indicated that affordable housing was the most important problem facing Hawaii.[5]

Energy is another major concern in Hawaii, because the state spends over one billion dollars annually, about 10 percent of gross state product, to import all of its crude oil.[6] Hawaii depends on imported petroleum,

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2 *The State of Hawaii Data Book: A Statistical Abstract*, Department of Business, Economic Development and Tourism, Honolulu, Hawaii, 1990, Table 5, p. 16.

3 Ilene Aleshire, "Oahu home prices doubled since '87," *The Honolulu Advertiser*, November 4, 1991, p. A4.

4 Thomas Kaser, "Chances of owning home here are just as dismal as in 1980," *The Honolulu Advertiser*, November 30, 1989, p. A1.

5 Jerry Burris, "Voters raising the roof over affordable housing," *The Honolulu Advertiser*, August 6, 1990, p. A3.

6 Maurice H. Kaya, "The State of Hawaii Energy Program," Department of Business and Economic Development, Honolulu, Hawaii, October 18, 1988, p. 1.

about half from foreign sources, for 92 percent of its energy needs.[7] For comparison, U.S. net imports of petroleum amounted to 41.9 percent of total petroleum consumption in 1990.[8] Hawaii's high dependence on imported petroleum and its remote location in the Pacific make it very vulnerable to any disruption in petroleum supply.

After Iraq invaded Kuwait in August 1990, Hawaii's four utilities announced increases in electricity rates due to fuel oil hikes. Those islands using higher percentages of renewable energy sources for electricity (i.e., biomass, hydroelectric, wind, and geothermal) had smaller increases in electricity rates, as shown below.

County	Percentage Increase in Household Electricity Rates for October and November, 1990 (9)	Percentage of Electricity from Renewable Sources (10)
Kauai	15.0	37
Hawaii	17.2	24
Maui	25.6	18
Oahu	35.4	6

7 *Hawaii Integrated Energy Policy*, Department of Business, Economic Development and Tourism, Honolulu, Hawaii, 1991, pp. 5, 14.

8 World Resources Institute, *The 1992 Information Please Environmental Almanac*, Houghton Mifflin Co., Boston, Massachusetts, 1991, p. 76.

9 Kit Smith, "HECO bills were higher in early '80s," *The Honolulu Advertiser*, October 2, 1990, p. A7.

10 *Hawaii Integrated Energy Policy*, Exhibit 8, p. 20.

B. State Response to the Affordable Housing Problem

The State of Hawaii has developed a program to produce more affordable housing. Act 337, *Session Laws of Hawaii*, 1987, empowers the state's Housing Finance and Development Corporation (HFDC) to acquire, master plan and develop large parcels for residential use. Act 337 enables HFDC to bypass many county permit requirements and to float bonds to finance infrastructure for these projects. Because Act 337 streamlines the development process and provides infrastructure, it reduces the developer's risk and profit margins. In return, the law requires developers to provide at least 60 percent of the housing units as "affordable", and the remaining units may be sold at "market" prices. Revenue from the sale of market units can be used by the developer to reduce the cost of the affordable units.

HFDC's first project under Act 337 was the Villages of Kapolei, a planned community on Oahu of nearly 4,800 housing units, scheduled for completion in 1998. By the year 2000, HFDC expects to construct another 3,900 housing units in Kealakehe on the Big Island and 4,800 units in Lahaina on the Island of Maui.[11] In December 1988, HFDC selected Oceanic Properties as the developer of 520 homes in Kapolei's Kumu Iki Village.[12] In fall 1989, Oceanic Properties sold the first 150 homes as Phase 1 of

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11 Jerry Tune, "Planned communities blossom," *The Sunday Star-Bulletin & Advertiser*, December 24, 1989, p. F1.

12 Jerry Tune, "C & C unit picked for Kapolei," *The Star-Bulletin*, December 29, 1988, pp. C1, C4.

Kumu Iki and delivered the first units to buyers during the spring of 1990. The affordable units at Kumu Iki, which ranged from $89,000 to $120,000, were priced for buyers with annual incomes less than $45,000, which was 120 percent of Oahu's median family income.[13] The market units of Phase 1 sold at prices from $178,900 to $289,300. In 1991, Oceanic Properties completed and sold 141 homes built under Phase 2 of the Kumu Iki project. Although prices of affordable units in Phase 2 did not change, prices of market units increased, ranging from $254,000 to $362,000.

C. State Goal to Make Houses More Energy Efficient

The Kapolei site is fairly flat, lacks shade trees and occupies one of the sunniest and warmest locations on Oahu. Oahu Sugar Company was using the site to grow sugar cane prior to its purchase by HFDC for development. HFDC's design guidelines for the Kapolei project followed fairly conventional criteria for promotion of health, safety, privacy, aesthetics and cost effectiveness. The guidelines called for wide, curvilinear streets to create visual interest. To make homes more affordable, the guidelines specified small lots ranging from 3,255 to 5,000 square feet with only ten to fifteen feet separation between houses.

The Kapolei site plan inhibited natural ventilation and passive cooling, because it proposed compact development on a flat site. With some exceptions, HFDC's design guidelines omitted and in some cases even

13 Housing Finance and Development Corporation, "Hula Mae Program: 1988 Series A," Honolulu, Hawaii. No date.

precluded opportunities for improvements in home energy efficiency. To promote energy conservation, the Energy Division of the Department of Business and Economic Development (DBED) began working with HFDC to make the Kapolei project more energy efficient. In early 1989, the Energy Division hired a group of consultants led by PBR Hawaii to develop a set of energy efficiency design guidelines for the Kapolei project. The objective of these guidelines was to minimize the energy use and cost of the project on a life-cycle basis. However, it was left to the developer's architects and engineers to work out the inevitable compromises between these guidelines and those that addressed other development objectives, i.e., aesthetics, privacy, cost-effectiveness, health and safety. In working out these compromises for Kumu Iki Village, energy efficiency was largely sacrificed. However, the builder did agree to preplumb units to enable homeowners to install solar water heating systems with less expense.

D. Increases in State Energy Income Tax Credits

In Hawaii, water heating represents between 30 and 50 percent, the largest component, of a typical household's utility bill.[14] Solar water heating systems and heat pump water heaters are the most effective technologies in Hawaii to achieve savings on utility bills. Hawaii's uniformly warm air and water temperatures increase the effectiveness of flat-plate solar collectors in comparison with other states. Warm, year-round

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14 "A Home-Owner's Guide to Solar Water Heating with Oahu Sunshine Map," Department of Business, Economic Development and Tourism, Honolulu, Hawaii, September 1991.

temperatures in Hawaii permit simpler, more efficient and less expensive designs because antifreeze is not required.

Most solar systems and heat pumps in Hawaii were installed prior to 1986, when homeowners could take advantage of a 40 percent federal income tax credit and a 10 percent state income tax credit. By 1987, homeowners had claimed state tax credits for 40,391 residential solar energy devices (10.5 percent of all housing units) and 6,228 residential heat pumps (1.6 percent of all housing units).[15] In recent years, Hawaii's solar and heat pump industry has seen a decline in consumer demand for these systems.[16] This decline occurred in part because the federal government discontinued income tax credits for solar water heaters in 1985.[17]

In January 1990, H.B. 3299 was introduced to the Legislature by Governor John Waihee at the request of the state's Health Director, Dr. John Lewin. This bill would have mandated the installation of solar systems or heat pumps in all new homes and would have provided 50 percent tax credits for the homeowner to defray their costs. In recent years, the public has criticized the Health Department for not sufficiently protecting them from geothermal energy development on the Big Island. Although

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15 *The State of Hawaii Data Book: A Statistical Abstract*, Department of Business, Economic Development and Tourism, Honolulu, Hawaii, 1990, Table 499 (p. 440) and Table 500 (p. 441).

16 Personal interview with Cully Judd, Inter-Island Solar Supply, August 4, 1989.

17 Walter A. Rosenbaum, *Energy, Politics, and Public Policy Second Edition*, Congressional Quarterly Inc., Washington, D.C., 1987, p. 200.

this bill was intended to promote energy conservation, it was also viewed as a means to defuse criticism of the state's program for geothermal development.

In spring 1990, the Legislature and Governor approved a compromise of H.B. 3299. Although the new law (Act 319, *Session Laws of Hawaii*, 1990) did not make installation of solar systems or heat pumps mandatory, it did increase state income tax credits for these systems. Previous law allowed a 15 percent tax credit on the actual cost of solar systems and heat pumps. The new law allows a homeowner to take 35 percent on the actual cost or a $1,750 tax credit, whichever is less, for installation of a solar hot water system on a single-family residence and 35 percent or $350, whichever is less, for each unit of multifamily dwellings. For installation of a heat pump, a homeowner may now take 20 percent of the actual cost or a $400 tax credit, whichever is less, for single-family residences and 20 percent or a $200 tax credit, whichever is less, for each unit of multifamily dwellings. These tax credits are effective between January 1, 1990 and December 31, 1998.

Given the increased tax credits for solar systems and heat pumps, the Energy Division has sought to make the state's affordable housing projects more energy efficient. To achieve this objective, the Energy Division asked HFDC to require installation of heat pumps or solar water heating systems in all new state housing projects. In 1991, HFDC adopted a

policy of including solar water heaters in these projects wherever possible.[18]

In April 1992, the Legislature passed H.B. 2319, which requires HFDC to install solar water heating equipment in housing projects constructed with state funds, located on state lands or otherwise subsidized by the state. This installation will be in accordance with the following percentages of housing units approved by HFDC between 1993 and 1995: 30 percent in 1993, 40 percent in 1994, and 50 percent in 1995. The remaining units are required to have alternate water heating systems, such as heat pumps, or high-efficiency gas or electric water heaters. In June 1992, Governor John Waihee approved H.B. 2319. The new law is Act 255, *Session Laws of Hawaii*, 1992.

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18 Andy Yamaguchi, "Isle oil dependency grows," *Honolulu Advertiser*, October 27, 1991, pp. A1, A4.

Chapter II

Energy-Efficient Mortgages

A. Description of Energy-Efficient Mortgages

In 1979, President Jimmy Carter issued an executive order that required mortgage underwriters to implement the energy-efficient mortgage (EEM) concept.[19] This concept allows mortgage underwriters (Department of Veterans Administration, Federal Housing Administration, Federal National Mortgage Association, and Federal Home Loan Mortgage Corporation) to permit a substantial portion of the cost of energy improvements to be included in a home mortgage. Since energy improvements result in savings on monthly utility bills, energy-efficient mortgages allow underwriters to count these savings towards the buyer's ability to make higher mortgage payments to pay for the improvements. In fall 1988, the state Energy Division asked the author to investigate the potential of energy-efficient mortgages for home buyers in Hawaii.

Figure A shows the mortgage loan process for a typical home buyer. Realtors and lenders play a key role in notifying the home buyer of the energy-efficient mortgage opportunity, particularly for conventional loans underwritten by the Federal National Mortgage Association (Fannie Mae)

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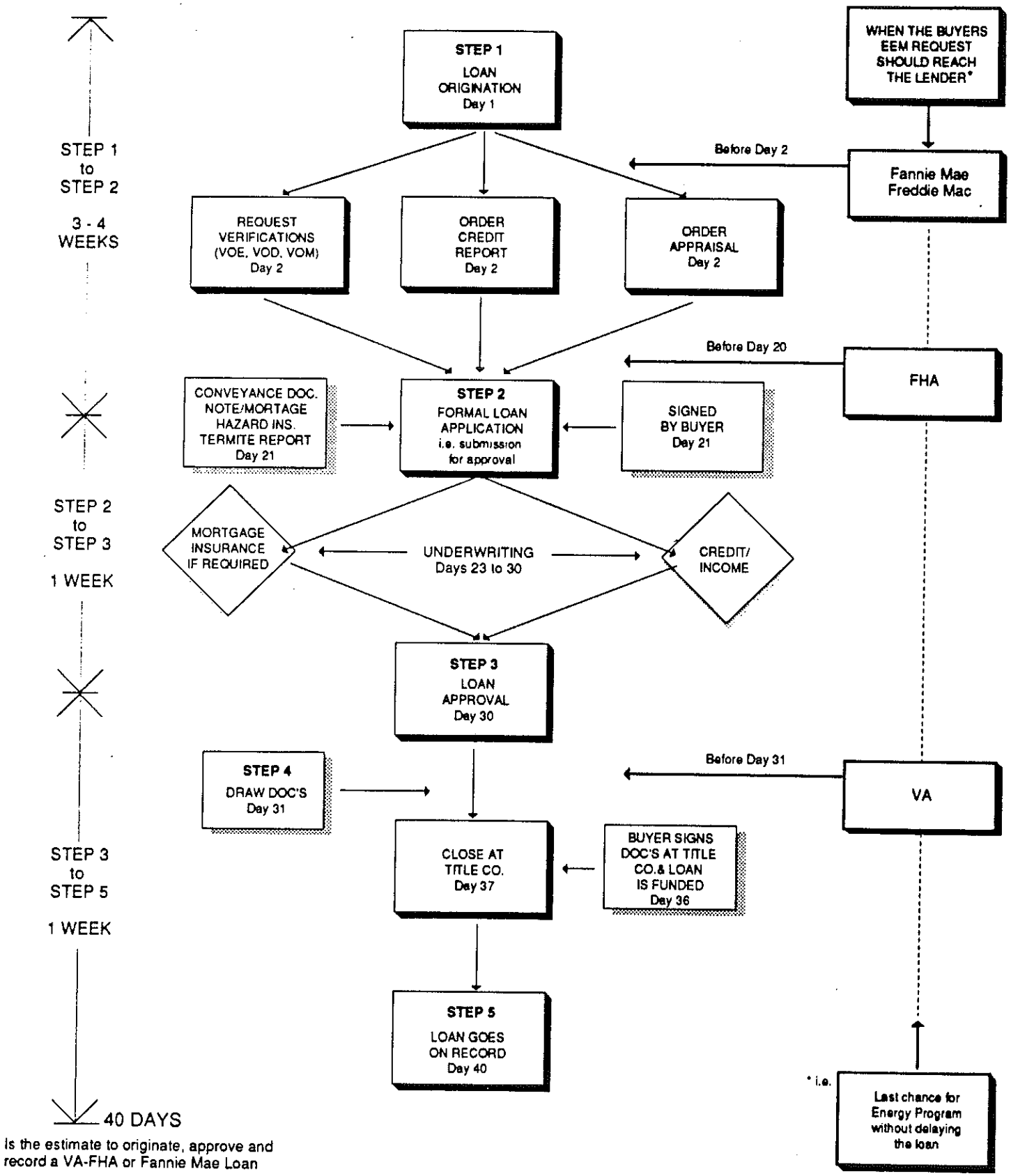
19 Executive Order No. 12-185, December 17, 1979.

Figure A. The Mortgage Loan Process



Source: Jim Curtis, Bay Area Energy Consultants, 3121 David Avenue, Palo Alto, California 94303

and the Federal Home Loan Mortgage Corporation (Freddie Mac). Home buyers who use conventional financing must inform lenders of their interest in an energy-efficient mortgage by the second day of the loan process. Buyers who apply for loans offered by the Federal Housing Administration (FHA) have 20 days to request an energy-efficient mortgage from the lender. Those who apply for loans through the Department of Veterans Administration (DVA) have 31 days.

Mortgage underwriters differ in their energy-efficient mortgage programs. Figure B shows how mortgage underwriters vary in terms of answers to seven basic questions:

1. When should the buyer's request for an energy-efficient mortgage reach the lender?
2. What dollar amount is available for energy improvements?
3. What amount of the improvement can be financed?
4. How does the lender determine that the energy improvement is acceptable?
5. What supporting documents are required?
6. When must the energy improvement be installed?
7. What incentives exist to the lender to participate in an energy-efficient mortgage program?

Mortgage underwriters do not have uniform guidelines for defining what is an energy-efficient home. Each home's energy efficiency is judged separately. Furthermore, the value of the energy improvement is not

Figure B. The Energy-Efficient Mortgage Matrix

Federal lending program	Day by which buyer's request must be made to the lender to insure normal processing time	Dollar amount available for energy improvements	Amount that can be financed	How improvements are determined acceptable	Supporting documents	When improvements must be installed	Incentives to lender
Veterans Admin. (VA)	Up to day 31 after loan origination (i.e., before the documents are drawn by the title company.	From base loan up to $184,000.	100% of cost.	By VA Designated Appraiser (DA) up to $3,500; by fee appraiser if over $3,500.	Bids and VA DA's statement of value.	180 days after loan is funded.	2% of the cost of improvements.
Federal Housing Admin. (FHA)	Up to day 20 (i.e., before base loan is submitted for approval).	100% of base loan (with 20% additional for solar).	For weatherization, 95% if base loan is less than $124,250; 100% if base loan is ≥ $124,250.	By regional arch. and engr. review and/or fee appraiser.	Bids and FHA arch. & engr. letter of acceptance from regional office.	Before loan is insured.	1% of the cost of improvements.
Federal National Mortgage Association (Fannie Mae)	Up to day 2 (i.e., before the appraisal is ordered).	15% of property value.	Normally up to loan to value (LTV) of 95%; 100% if LTV is less than 75%.	By fee appraiser per Form 70A. None if LTV is less than 75%.	Bids and Energy Addendum (i.e., Form 70A).	120 days after loan is funded.	Origination fee x cost of improvements.
Federal Home Loan Mortgage Corp. (Freddie Mac)	Up to day 2 (i.e., before the appraisal is ordered).	10% of loan amount	Normally up to LTVs of 95%; 100% if LTV is less than 75%.	By fee appraiser per Form 70A. None if LTV is less than 75%.	Bids and Energy Addendum (i.e., Form 70A).	180 days after loan is funded	Origination fee x cost of improvements.

Source: Jim Curtis, Bay Area Energy Consultants, 3121 David Avenue, Palo Alto, California 94303

necessarily its cost. Appraisers must look to comparable properties to determine value.

Mortgage underwriters use input rather than performance standards to qualify homes as energy efficient. For simplicity and ease of use, underwriters have adopted rating systems that are merely checklists of home energy-efficient features. In effect, underwriters do not estimate how much energy is actually saved by each feature (individually or in combination) or how much money could be saved monthly on utility bills. These checklists are used by property appraisers, who often are not familiar with home energy dynamics.

Two methods are used to determine whether a dwelling is energy efficient for buyers using conventional financing. The first method uses an independent fee appraiser or an "energy expert" from the local utility if the appraiser is unable to make a judgment. The appraiser first determines whether a dwelling contains energy-saving features pertaining to insulation, windows and doors, and heating and cooling systems. The appraiser then assigns an overall rating (high, adequate, low) using an Energy Addendum. (Appendix A shows a blank copy of an Energy Addendum.) The rating must be "high" for the buyer to be a candidate for an energy-efficient mortgage. This method applies for both new construction and for existing homes.[20] The second method applies to new home

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20 See: Sections 501.05 and 502.07 of Fannie Mae, *Underwriting Guidelines*, May 1, 1988, pp. 76-77, 82-84.

construction only. Instead of using the Energy Addendum, this method requires homes to be built in compliance with the Thermal Performance Guidelines issued by the National Association of Home Builders. Lenders simply provide evidence that the dwelling was built in accordance with a qualifying energy conservation program.[21]

Fannie Mae and FHA use "stretched ratios" to qualify a buyer for a larger home loan to cover the additional cost of energy improvements. Table 1 gives their guidelines on qualifying ratios for standard and energy-efficient mortgages. Freddie Mac allows lenders to credit the projected energy savings against the borrower's mortgage payment, but the savings can not cause the qualifying ratio to be stretched more than four percentage points. Although Freddie Mac uses a different approach, the effect is similar in helping borrowers qualify for energy-efficient homes. The additional two to four percentage points in the qualifying ratio is somewhat arbitrary, because the energy industry can not agree on real numbers (i.e., savings) to attach to different types of energy improvements.[22] Even higher ratios may be allowed, if the buyer has a sufficiently large income and/or assets. If the borrower already exceeds the ratios above, an energy-efficient mortgage may be of little value.

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21 See: Section 2214 of Freddie Mac, *Sellers' & Servicers' Guide, Volume 1*, October 30, 1987, pp. 104-105.

22 Comments made by Mark Simpson at a policy forum and conference on "Making Housing More Affordable Through Energy Efficiency," The Alliance to Save Energy, Washington, D.C., October 6, 1989.

Table 1. Qualifying Ratios for Standard and Energy-Efficient Mortgages

	PITI/GFI [a]	Total Debt/GFI
Fannie Mae [b]		
Standard mortgage	28%	36%
Energy-efficient mortgage	30%	38%
FHA [c]		
Standard mortgage	29%	41%
Energy-efficient mortgage	31%	43%

a. PITI = principal, interest, taxes and insurance
GFI = gross family income

b. Section 501.05 of Fannie Mae, *Underwriting Guidelines*, May 1, 1988, pp. 76-77.

c. C. Austin Fitts, Mortgagee Letter 89-25, Office of the Assistant Secretary for Housing, Federal Housing Commissioner, October 20, 1989.

B. Evaluation of Energy-Efficient Mortgages

Jim Curtis, President of Bay Area Energy Consultants in Palo Alto, California, has helped over 2,100 home buyers in California obtain energy-efficient mortgages during the last decade. Curtis estimated that every $1,000 worth of energy-saving equipment added to a house and financed through a mortgage loan costs 29 cents per day, assuming a 30-year fixed mortgage at 10 percent, but saves an average 49 cents per day over a five-year period. The difference between savings and investment is 20 cents per day or $365 in savings per $1,000 of investment over a five-year period.[23]

In a very competitive housing market, energy-efficient mortgages allow some lending institutions to capture a larger share of the market because borrowers can qualify at higher debt-to-income ratios. Some builders like energy-efficient mortgages because they don't have to send a lender three potential borrowers to get one qualified. In effect, stretched qualifying ratios expand the pool of potential home buyers. An energy-efficient mortgage appears to work best for new construction rather than for resales. On a resale, energy improvements are more likely to cost too much, because the house design is suboptimal. This situation may create

23 Comments made by Jim Curtis at a policy forum and conference on "Making Housing More Affordable Through Energy Efficiency," The Alliance to Save Energy, Washington, D.C., October 5, 1989.

uncertainty among lenders over whether energy savings created by these improvements are real.[24]

Many home buyers have not taken advantage of energy-efficient mortgage programs. Only 20,000 energy-efficient mortgages, out of 70 million mortgages of all types for single-family residences, were contracted since the inception of these programs in 1980.[25] There are several reasons for lack of home buyer and lender interest in energy-efficient mortgages. First, real oil prices dropped dramatically during the 1980s. Oil prices adjusted for inflation in 1988 were less than half of those prices in 1979.[26] Second, realtors and home buyers generally don't know about energy-efficient mortgage programs. The National Association of Realtors had a guide in 1980 on selling energy-efficient homes.[27] However, that guide did not address the features or benefits of energy-efficient mortgage programs. Third, primary lenders and mortgage underwriters have difficulty quantifying future energy savings. Energy use is highly dependent on the behavior of the family who occupies the home, i.e., the life-style

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24 Comments made by Thomas Fitzgibbon at a policy forum and conference on "Making Housing More Affordable Through Energy Efficiency," The Alliance to Save Energy, Washington, D.C., October 6, 1989.

25 Camille M. Antinori, "A breakthrough for energy-efficient mortgages," *Home Energy*, Vol. 8, No. 5, September/October 1991, p. 31.

26 Thomas W. Lippman, "Priming the pump for steadily rising oil prices," *The Washington Post National Weekly Edition*, April 30-May 6, 1990, p. 20.

27 *The REALTOR'S Guide to Residential Energy Efficiency: An Introduction in Using Energy to Sell Homes*, National Association of Realtors, Washington, D.C., 1980.

variable. Fourth, some home buyers who participated in energy-efficient mortgage programs found that they added to closing costs substantially and delayed the date for closing escrow. Fifth, the different types of energy-efficient mortgage programs currently confuse home buyers.

C Tailoring the Energy-Efficient Mortgage to Hawaii

In Hawaii, home buyers have not used energy-efficient mortgages for two reasons: (1) home buyers here are largely unaware of these mortgages; and (2) homes must have improvements that reduce space heating costs to qualify for these mortgages. Since Hawaii does not have a heating season, energy-efficient mortgages appear irrelevant to local buyers.

In January 1990, Governor John Waihee and then-DBED Director Roger Ulveling each sent letters to Ms. C. Austin Fitts, Assistant Secretary for Housing in the U.S. Department of Housing and Urban Development (HUD), asking her to reconsider FHA's criteria for qualifying energy-efficient homes in Hawaii. The state wanted FHA's criteria to recognize Hawaii's tropical climate and the significance of water heating as the largest component of household utility bills. In April 1990, HUD agreed to allow a one percent increase in the qualifying ratios, but only when a HUD-approved solar domestic hot water system is used in new construction.[28] Appendix B is a list of HUD-approved solar water heating systems.

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28 Letter from C. Austin Fitts, Assistant Secretary for Housing, Federal Housing Commissioner, to Governor John Waihee, State of Hawaii, April 2, 1990.

D. A Uniform Energy-Efficient Mortgage

For several years, the Alliance to Save Energy, a nonprofit coalition of business, government, and consumer leaders dedicated to increasing the efficiency of energy use, has advocated for more uniformity among the different energy-efficient mortgage programs. In October 1989, the Alliance organized a policy forum and conference in Washington, D.C. on "Making Housing More Affordable Through Energy Efficiency". Speakers at the conference identified several market barriers that work against greater energy efficiency in the housing industry. These barriers include: "lax building codes, lack of consumer and professional education on energy efficiency in homes, lack of financing for energy improvements, lack of incentive for builders and landlords to invest in efficiency, and many others."[29]

The Planning Committee for the Washington conference proposed several policy initiatives to address some of the key barriers to greater home energy efficiency. One initiative proposed a national uniform energy efficiency mortgage policy understandable to home builders, lenders, buyers and realtors. Another initiative called for federal guidelines that would enable states to develop better home energy rating systems (HERS) for consumers and housing professionals to assess home energy efficiency. Home energy rating systems enable banks to determine lower risk borrowers, because buyers of energy-efficient homes have reduced energy costs during home ownership.

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29 "Summary of Proceedings: Making Housing More Affordable Through Energy Efficiency," The Alliance to Save Energy, Washington, D.C., October 4-6, 1989, p. 1.

In November 1990, Congress authorized the Secretary of the Department of Housing and Urban Development in consultation with the Secretary of the Department of Energy "to promulgate a uniform plan to make housing more affordable through mortgage financing incentives for energy efficiency".[30] As a result, HUD established a task force of mortgage bankers, home builders, real estate brokers, private mortgage insurers, energy suppliers and members of nonprofit housing and energy organizations to develop the criteria for a uniform energy-efficient mortgage.

Recently, the banking industry has shown more interest in energy-efficient mortgages due to the 1989 and 1991 amendments of the Community Reinvestment Act of 1977. Under this law, federal regulatory agencies have begun to scrutinize bank performance more carefully. Banks that issue energy-efficient mortgages can obtain more favorable reviews from these agencies. The law also enables better tracking of the number of energy-efficient mortgages that are actually made by banks, thus plugging a major gap in information about these mortgages.[31]

In October 1992, Congress and President George Bush approved P.L. 102-486, the Energy Policy Act of 1992. In this Act, Section 106 of Title 1--Energy Efficiency establishes provisions for a uniform energy-

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30 "Section 946, Uniform Mortgage Financing Plan for Energy Efficiency," *Cranston-Gonzalez National Affordable Housing Act*, P.L. 101-625, November 28, 1990.

31 Rebecca Vories, "Making 'HERS' a Household Word," *Home Energy*, Vol. 8, No. 5, September/October 1991, pp. 30, 32-35.

efficient mortgage program. Table 2 gives a summary of these provisions. The law, which applies to both attached and unattached single-family dwellings, requires HUD to: (a) establish an energy-efficient mortgage pilot program in five states; (b) assess the potential for expanding the pilot program nationwide; and (c) report to Congress on the results of the pilot program by April, 1994.[32]

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32 U.S. House of Representatives, *Energy Policy Act of 1992 Conference Report to Accompany H.R. 776,* House Report 102-1018, Government Printing Office, Washington, D.C., 1992.

Table 2. Provisions for a Uniform Energy-Efficient Mortgage Program in the Energy Policy Act of 1992

- The cost of cost-effective energy efficiency improvements shall not exceed the greater of (i) 5 percent of the property value (not to exceed $8,000) or (ii) $4,000.

- The mortgage loan can include 100 percent of the cost of the cost-effective energy efficiency improvements, if the home buyer's request for an energy-efficient mortgage is received by the lender prior to funding of the base loan, i.e., the loan that does not include the cost of cost-effective energy improvements.

- The term "cost-effective" means improvements that result in the total present value cost of the improvements (including any maintenance and repair expenses) being less than the total present value of the energy saved over the useful life of the improvement, when 100 percent of the cost of improvements is added to the base loan.

- Savings and cost-effectiveness shall be determined by a home energy rating report that satisfies the Federal National Mortgage Association (Fannie Mae) and the Federal Home Loan Mortgage Corporation (Freddie Mac), or by other technically accurate methods.

- The energy-efficient mortgage shall have the effect of not disqualifying a borrower who, but for the expenditures on energy saving construction or improvements, would otherwise have qualified for a base loan.

Chapter III

Case Study of Financial Impacts

A. Purpose and Scope of Study

In 1990, the state Legislature debated whether to approve H.B. 3299, the bill that would have mandated installation of heat pumps or solar water heating systems for newly constructed housing in Hawaii. Although the Legislature deleted the requirement for mandatory installation of these systems from the final version of the bill, it did increase state income tax credits for these systems under Act 319, *Session Laws of Hawaii*, 1990. Two years later the Legislature and Governor John Waihee approved Act 255, *Session Laws of Hawaii*, 1992. This law requires the state Housing Finance and Development Corporation (HFDC) to install solar water heating systems in specified percentages of the total number of housing units in future residential projects that it approves between 1993 and 1995, and alternate water heating systems in the balance of these units.

This chapter describes a case study of the financial impacts on families of Acts 255 and 319. This study addresses two questions:

1. How much additional family income will be needed to qualify for the larger mortgage on a new house with the energy improvement, compared to an identical house without it, given

that a major portion of the improvement's cost is included in the mortgage loan?

2. What will be the net effect on the family's pocketbook of all cash gains and losses associated with the energy improvement after two- and five-year periods of home ownership?

Since Act 255 applies to state housing projects approved between 1993 and 1995, the actual financial impacts on families of these two laws will depend on economic factors and conditions that are in effect during that period and beyond. Forecasts of these factors and conditions are difficult to make and beyond the scope of this study. Hence, the study took a retrospective approach and used counterfactual analysis to estimate financial impacts. Specifically, the study focused on families that bought homes in either 1990 or 1991 in Kumu Iki Village of the Villages of Kapolei, one of the state's affordable housing projects on Oahu's Ewa Plain. Since Act 255 did not require the state to install energy efficiency improvements in Kumu Iki Village, the report addresses the following question: What would have been the financial impacts on families now living in Kumu Iki Village, if the requirements of Act 255 had been in effect for that project?

In this chapter, Section B describes the assumptions and methodology of the case study, Section C discusses how financial impacts were computed, and Sections D and E, respectively, answer the two questions raised above.

B. Assumptions and Methodology of Study

The estimation of financial impacts required assumptions on several issues: (1) the size and cost parameters of each energy improvement; (2) levels of home energy consumption, particularly water heating loads for each type of energy improvement; (3) utility rates and their inflation over time; (4) the type of mortgage financing (i.e., the amount of down payment, interest rates, points, mortgage insurance) needed to purchase homes of various prices; (5) property taxes; and (6) the length of home ownership.

The study focused on the first two phases of development in the Village of Kumu Iki at Kapolei. Most buyers took occupancy of homes in Kumu Iki during 1990 for Phase 1 and during 1991 for Phase 2. Thus, information on utility rates and mortgage financing was obtained for conditions prevailing during mid-year of 1990 and 1991. Based on data from HFDC for 294 units in these two phases combined, the median household size was determined to be four persons.[33] Thus, the size and cost of energy improvements and levels of energy consumption were scaled to a family of four.

1. Size and Cost Parameters of Energy Improvements

Estimating what would be the price of homes with energy improvements was complicated by three factors. First, the developer, Oceanic Properties, and its principal builder, Mililani Town, Inc., had already agreed with HFDC to install standard gas water heaters and gas ranges in

33 Facsimile communication to the author from Karen Tamura, HFDC, September 9, 1991.

Kumu Iki homes, because HFDC had decided to provide Kumu Iki with both gas and electricity. Second, if the home builder had installed energy improvements, then the builder would have realized volume discounts on purchase of multiple units of these improvements. Third, the builder had agreed with HFDC to preplumb the housing units for solar systems.

The author interviewed several local energy consultants, contractors and suppliers of water heating equipment to determine the appropriate size and cost of each type of energy improvement for a family of four living in a two or three bedroom house.[34] There was consensus among those interviewed that a family of four would need at least an 80-gallon tank for either the solar system or heat pump, and a 40- to 50-gallon tank for a high-efficiency water heater. The size of solar panels would need to be only 40-square feet given that the Kapolei project is in a sunny and warm location on Oahu. Table 3 gives the specifications and estimated supplier and net installed unit costs for each type of energy improvement. The supplier's unit cost has been discounted to reflect a volume purchase by the builder of 150 units. The net installed costs include an estimate of the builder's markups for labor and overhead.

2. Home Energy Consumption

Estimates of home energy consumption for a family of four at Kumu Iki were based on information provided by the local gas and electric

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34 The following individuals and firms in Honolulu provided information: Bill Anderson of Andersun Solar; Michael Fitzgerald of Ecosystems; Eric Inouye of Western Pacific Energy Systems, Inc.; and Cully Judd of Inter-Island Solar Supply.

Table 3. Specifications and Estimated Costs for Improvements in Energy Efficiency to Heat Water

Energy Improvement	Specifications	Supplier's Unit Price [a]	Net Installed Cost
High-efficiency gas water heater	40-gallon tank	$685	$950
High-efficiency electric water heater	50-gallon tank	$475	$650
Integral heat pump water heater	80-gallon tank	$1,194	$2,000
Solar water heater	80-gallon tank 40 ft.^{2} panel	$1,275	$4,000

a. Source: Inter-Island Solar Supply, Honolulu, Hawaii

companies. Hawaiian Electric Company (HECO) estimated that a family of four using a standard water heater would consume 400 kilowatthours (kwh) of electricity to heat water and that water heating would constitute 40 percent of the family's electric bill.[35] The consumption of 400 kwh was calculated to be equivalent to about 20 therms of gas per month.[36] In contrast, the Gas Company (Gasco) provided much lower estimates based on actual data for 108 homes at Kumu Iki that had gas service for at least eight months. Gasco estimated that a family of four was consuming an average of only 13.36 therms of gas per month to heat water and operate a range.[37] Of this amount, Gasco estimated that the gas range used 2 to 2.5 therms per month.[38] Hence, the gas water heater itself was using 10.86 to 11.36 therms per month. The author selected the mid-point of this range (about 11.1 therms per month) for subsequent calculations. This level of gas consumption is equivalent to about 223 kwh per month of electricity.

Gasco stated that their Kumu Iki gas consumption figures were about 5 therms per month below statewide averages for a family of four. This difference could be due to the fact that gas appliances in Kumu Iki are newer and more efficient than gas appliances throughout the state.

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35 Letter to the author from Alan S. Lloyd, Executive Staff Engineer, Hawaiian Electric Company, June 6, 1989.

36 $$20 \text{ therms} = \frac{400 \text{ kwh} * 3{,}414 \text{ Btu/kwh} * (0.95 \text{ efficiency factor})}{100{,}000 \text{ Btu/therm} * (0.65 \text{ efficiency factor})}$$

37 Gasco Marketing, "The Gas Company Kumu Iki Gas Consumption Analysis, July, 1991," The Gas Company, Honolulu, Hawaii, March, 1992.

38 Facsimile communication to the author from Steven Golden, IRP Manager, Gasco, October 10, 1991.

Given HECO's and Gasco's different estimates of energy consumption for standard water heaters at Kumu Iki, the state Energy Division advised the author to include both estimates in this study. Hence, it was assumed that a 40-gallon standard gas water heater serving a family of four in Kumu Iki was consuming between 11.1 and 20 therms per month. It was further assumed that if the builder had installed a standard 40-gallon electric water heater, the family would consume between 223 and 400 kwh per month for water heating.

A number of additional assumptions were necessary. First, it was assumed that the builder would not have provided any other gas appliances (e.g., a gas range), if standard electric water heaters had been installed. Second, it was assumed that a family of four would need basic service of 445 kwh per month for all electrical end uses other than the water heater and range. Third, if a gas range was installed, consumption was assumed to vary from 2.3 to 3.4 therms per month. If an electric range was installed, consumption was assumed to vary from 36.4 to 55 kwh per month. Fourth, the following assumptions were made regarding the energy savings of each water heating efficiency improvement when compared to standard gas or electric water heaters:

Type of Improvement	Energy Savings	Percentage Reduction
High-efficiency gas	2.6 - 3.1 therms/month	19%
High-efficiency electric	22.3 - 40 kwh/month	10%
Heat pump	145 - 260 kwh/month	65%
Solar system	200 - 360 kwh/month	90%

Table 4 summarizes estimates of low and high levels of energy consumption at Kumu Iki for hypothetical homes with these water heating improvements and for actual homes without these improvements. For identical homes without energy improvements, estimates are shown both for existing homes with gas and electric appliances and hypothetical homes with all-electric appliances.

3. Energy Costs

The state's Public Utilities Commission (PUC) allows local utilities to levy a monthly service charge on residential customers and a separate charge for actual energy consumption. This consumption is broken down into three components: the non-fuel energy or operating cost, the base fuel energy cost, and the fuel adjustment charge. The first two components are regulated by the PUC, while the fuel adjustment charge may vary month to month depending on the price of fuel.

Oahu's electric and gas companies provided basic information on utility rates and service charges in 1990 and 1991.[39] This information was then verified with information from monthly bills for these two time periods from three utility customers.[40] An analysis of all utility bills showed that utility rates, as averaged over an entire year for both residential gas and electric service, were slightly greater in 1991 than in 1990.

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39 Phone conversations with Stewart Cooley of Hawaiian Electric Co. and Jim Severson of Gasco Inc., May 25, 1990 and January 22, 1992, respectively.

40 They are the Geilsuss family who live in Ewa, the Miyatake family who live in Waipahu, and the author who lives in Kaneohe.

Table 4. Low and High Estimates of Monthly Home Energy Consumption

	Low	High
Homes without Energy Efficiency Improvements		
Existing homes with some gas appliances [a]		
Electricity (kwh)	445	445
Gas (therms) [b]	13.4	23.4
Hypothetical all-electric homes (kwh) [c]	704	900
Hypothetical Homes with Energy Efficiency Improvements		
Homes with high-efficiency gas water heaters		
Electricity (kwh)	445	445
Gas (therms)	10.8	20.3
Homes with high-efficiency electric water heaters		
Electricity (kwh)	682	860
Homes with heat pump water heaters		
Electricity (kwh)	559	640
Homes with solar water heaters		
Electricity (kwh)	504	540

a. Includes gas range and gas water heater only.
b. Range: 2.3 - 3.4 therms/mo.; water heater: 11.1 - 20 therms/mo.
c. Range: 36 - 55 kwh/mo.; water heater: 223 - 400 kwh/mo.; other end uses: 445 kwh/mo.

For 1990, the average rates were 8.31 cents per kwh and $1.28 per therm. These rates do not include the service charge, which was $6 per month for each utility. For 1991, the average rates were 8.65 cents per kwh and $1.44 per therm, with a monthly service charge of $7 per month for electric service and $6 per month for gas service.

Table 5 provides estimates of low and high monthly energy costs for houses in Kumu Iki with and without efficiency improvements in water heating. These estimates are based on the service charges and average utility rates given above coupled with the energy consumption estimates given in Table 4.

4. Mortgage Financing

Home prices at Kumu Iki Village varied from $89,000 to $120,000 for the affordable units. The market-priced units varied from $178,900 to $289,300 for Phase 1, and from $254,000 to $362,000 for Phase 2. HFDC indicated that FHA/Hula Mae financing would be used for the affordable units.[41] It was assumed that either FHA or conventional financing, underwritten by Fannie Mae or Freddie Mac, would be used for market-priced units.

In recent years, maximum mortgage loan limits have been raised in Hawaii to enable buyers to keep up with rapidly escalating housing prices.

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41 Personal communication with Herbert Yamani, HFDC, March 1, 1989.

Table 5. Estimates of Monthly Home Energy Costs

Homes without Improvements in Energy Efficiency

Type of Home		Phase 1--1990 Low	Phase 1--1990 High	Phase 2--1991 Low	Phase 2--1991 High
• Existing homes					
	Electricity	$42.98	$42.98	$45.49	$45.49
	Gas	$23.15	$35.95	$25.30	$39.70
	Total monthly bill	$66.13	$78.93	$70.79	$85.19
• Hypothetical all-electric homes		$64.50	$80.79	$67.90	$84.85

Homes with Improvements in Energy Efficiency

Energy Improvement		Phase 1--1990 Low	Phase 1--1990 High	Phase 2--1991 Low	Phase 2--1991 High
• High-efficiency gas water heater					
	Electricity	$42.98	$42.98	$45.49	$45.49
	Gas	$19.82	$31.98	$21.55	$35.23
	Total monthly bill	$62.80	$74.96	$67.04	$80.72
• High-efficiency electric water heater		$62.67	$77.47	$65.99	$81.39
• Heat pump water heater		$52.45	$59.18	$55.35	$62.36
• Solar water heater		$47.88	$50.87	$50.60	$53.71

The maximum FHA loan obtainable was $151,850 in 1989. This limit was raised to $180,500 in 1990 and then raised again to $187,300 on August 1, 1991.[42,43] In 1989, the maximum conventional loan in Hawaii given a 20 percent down payment was $281,400.[44] This amount was adequate to purchase most of the market-priced units in Kumu Iki.

Regardless of the type of financing, it was assumed that all home buyers would use a 30-year, fixed-rate mortgage. Table 6 shows the financing assumptions for different housing markets for each phase of development. The housing prices shown in the table are averages of the different models sold in each category.

It was also assumed that a buyer who bought a house with a solar water heater and who used FHA financing, with or without the state's program of Hula Mae financing, would be eligible for an energy-efficient mortgage. Such mortgages enable lenders to allow the total house payment (principal, interest, taxes, and insurance) to be 30 percent, instead of 29 percent, of gross family income under FHA's revised underwriting guidelines for new homes with approved solar systems in Hawaii. This one

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42 Ilene Aleshire, "Isle home-seekers get big break, but sellers may too," *Honolulu Advertiser*, January 13, 1990, pp. A1, A4.

43 Rob Perez, "FHA-insured mortgage ceiling rises to $187,300," *Sunday Star Bulletin and Advertiser*, August 25, 1991, p. D1.

44 Personal communication with Marshall Brown, United Mortgage, August 25, 1989.

Table 6. Mortgage Loan Financing Assumptions

Home Model	Estimated Average Price	Type of Financing	Down Payment	Interest Rate	Points
Affordable Housing					
IA	$96,000	FHA/Hula Mae	5.0%	8.625%	1.00
IB	$102,000	FHA/Hula Mae	5.0%	8.625%	1.00
IC	$109,000	FHA/Hula Mae	5.0%	8.625%	1.00
ID	$118,000	FHA/Hula Mae	5.0%	8.625%	1.00
IIA	$120,000	FHA/Hula Mae	5.0%	8.625%	1.00
Mid-level Market Housing					
Phase 1					
IIB	$189,170	FHA	14.0%	9.500%	3.00
IIC	$208,180	FHA	22.5%	9.500%	3.00
Phase 2					
IIA &B	$264,893	Conventional	20.0%	9.625%	2.00
IIC	$279,208	Conventional	20.0%	9.625%	2.00
Upper-level Market Housing					
Phase 1					
IIIB	$234,860	Conventional	20.0%	10.125%	2.00
IIIC	$247,980	Conventional	20.0%	10.125%	2.00
IIID	$264,600	Conventional	20.0%	10.125%	2.00
IIIE	$279,307	Conventional	20.0%	10.125%	2.00
Phase 2					
IIIB	$297,294	Conventional	20.0%	9.625%	2.00
IIIC	$316,765	Conventional	20.0%	9.625%	2.00
IIID	$333,444	Conventional	20.0%	9.625%	2.00
IIIE	$339,571	Conventional	20.0%	9.625%	2.00

percent increase recognizes that the expected savings in monthly utility bills from the energy improvement would offset to a greater or lesser extent the increase in the monthly mortgage payments to pay for the improvement.

For conventional mortgage financing, the total house payment had to be equal to or less than 28 percent of gross family income. It was assumed that conventional mortgage underwriters would credit borrowers for their reduced utility bills when calculating the borrower's qualifying income. In such cases, the underwriter treats reduced utility bills as a compensating factor that enhances borrowing ability. Conventional mortgage underwriters have not yet approved stretched qualifying ratios for homes with solar systems in Hawaii.

For solar water heating systems only, FHA will allow to be included in the mortgage loan the lower of either the system's replacement cost or its effect on property value. For example, if a system costs $4,000 to install, but it increases the appraised property value by only $2,500, FHA would allow only $2,500 to be added to the loan amount. The difference of $1,500 would become a cash expense to the borrower at time of purchase.[45] For this study, it was assumed that the full cost of the solar system could and would be included in the mortgage loan. For the other improvements in energy efficiency, it was assumed that the buyer made some down payment towards the cost of these improvements.

45 Facsimile communication to the author from Cheryl Fukunaga, U.S. Department of Housing and Urban Development, Honolulu, Hawaii, October 30, 1992.

5. Property Taxes

Property tax rates for Kumu Iki were obtained from the Real Property Assessment Division of the City and County of Honolulu. For the study period, the rates were $4.09 per $1,000 of assessed valuation for land and $3.25 per $1,000 of net assessed valuation for buildings. Because these rates were in effect from July 1, 1990 to June 30, 1991, they were used in calculating the initial property tax payments of home buyers in both Phases 1 and 2 of Kumu Iki Village. The Real Property Assessment Division recommended that for affordable homes 80 percent of the home price should be used to determine the assessed valuation for land and 20 percent of that valuation should be allocated to the building. For market-priced homes, they recommended that 60 percent of the home price should be used to determine the assessed valuation for land and 40 percent of that valuation should be allocated to the building.[46]

The Real Property Assessment Division stated that appraised property values ordinarily are not affected by the presence or absence of most improvements in energy efficiency to heat water. However, they said that if solar water heating systems were installed in all houses of a new subdivision, these systems could increase property values of these houses, but so far there was no precedent for that on Oahu.[47]

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46 Personal communication with Real Property Assessment Division, City and County of Honolulu, Hawaii, January 22, 1992.

47 Personal communication with Real Property Assessment Division, City and County of Honolulu, Hawaii, October 14, 1992.

A $40,000 tax exemption on the assessed valuation for buildings was included on the assumption that most Kumu Iki home buyers would be under age 55. In March 1992, OmniTrak reported that the median age of home buyers at Kapolei was 26.3, which supports this assumption.[48]

6. Home Ownership Period

The analysis of financial impacts could be done from a public perspective or the homeowner's perspective. The public perspective is concerned with total social costs versus total social benefits over the life of the home, which may be several decades. From the homeowner's perspective, the pay-back period of an energy improvement should be less than or equal to the length of time that the house is owned, which averages five to seven years nationwide.[49]

This study purposely took the homeowner's perspective and looked at two periods of home ownership: two years and five years. The two-year period was selected to determine whether the financial benefits of energy improvements exceeded their costs under a less favorable assumption regarding the length of home ownership. The five-year period was thought to be closer to the typical length of home ownership on Oahu. In addition, some of the assumptions of the study were not expected to hold much beyond five years.

48 Jerry Tune, "Residents at Kapolei more likely to own," *Honolulu Advertiser*, March 8, 1992, p. G3.

49 Comments made by Rosalie Ruegg at a policy forum and conference on "Making Housing More Affordable Through Energy Efficiency," The Alliance to Save Energy, Washington, D.C., October 5, 1989.

C Computation of Financial Impacts

This section discusses the procedures used to compute financial impacts on home buyers of energy efficiency improvements for water heating that are mandated by Act 255 for state housing projects. These impacts were estimated for each type of improvement (i.e., high-efficiency gas and electric water heaters, and heat pump and solar water heaters), for 11 model homes at Kumu Iki Village, and for both two- and five-year periods of home ownership. Impacts had to be estimated separately for Phases 1 and 2 of the Kumu Iki project, because of price differences in market-priced homes, and differences in mortgage financing rates and utility rates during these two phases. In addition, the Energy Division recommended that impacts be estimated under both low and high levels of energy consumption to heat water, as provided by the local utilities.

If the builder of Kumu Iki had installed energy efficiency improvements in water heating and had passed their costs onto home buyers, these buyers would have realized two types of financial impacts. One impact is the additional family income that would be needed to qualify for the larger mortgage on a new house with the energy improvement, compared to an identical house without it, given that a major portion of the cost of the improvement is included in the mortgage loan. The second impact is the net effect on the family's pocketbook of all cash gains and losses associated with the energy improvement after two- and five-year periods of home ownership.

To determine the first impact, the study compared buyers who purchased hypothetical homes with improvements in energy efficiency to heat

water with buyers who purchased identical but real homes without these improvements at Kumu Iki. Appendix C illustrates the calculations on mortgage financing for 11 model homes in Phase 1 of Kumu Iki. Calculations were made for homes with and without energy improvements to determine: (1) the size of both the down payment and mortgage loan; (2) the monthly principal, interest, property taxes, and hazard insurance (PITI); and (3) the required gross annual income necessary to qualify for the loan. (The calculations for Phase 2 are not included in this report, because they are similar to those shown in Appendix C for Phase 1.) The formulae for these calculations are in Appendix D-1.

To determine the second impact, the study calculated both benefits and costs for a homeowner's pocketbook for each improvement in energy efficiency to heat water. The formulae for calculating these benefits and costs are in Appendix D-2.

The benefits are twofold: One benefit is the state income tax credit, which applies to solar and heat pump water heating systems only. Tax credits were computed according to the provisions of Act 319, which specifies a tax credit of 35 percent of the actual cost or $1,750, whichever is less, for installation of a solar water heater and 20 percent of the actual cost or $400, whichever is less, for installation of a heat pump water heater in a single-family residence. It was assumed that the homeowner received these tax credits eight months after closing escrow on the home and would have kept them in a checking or savings account that earned four percent per year compounded monthly. Federal and state taxes were computed on interest earned on the tax credits at the marginal tax rates of

25 percent for homeowners with affordable units and 38 percent for those with market-priced units.

Another benefit is the monthly savings on utility bills. Savings on utility bills were assumed to grow at four percent per year compounded monthly. This growth rate in utility savings was expected for two reasons. First, consumption of energy per household member was expected to increase over time, as younger members of the family matured and needed more hot water. Secondly, utility rates themselves were expected to climb gradually over time.

There are three types of costs on the homeowner's pocketbook. One is a relatively small increase in the down payment, and any foregone interest that may have accrued on that amount, to pay for the cost of the energy improvement. Foregone interest was calculated at a rate of four percent per year compounded monthly less any federal and state taxes, which were computed at the marginal tax rates discussed above.

A second and related cost is the additional amount in the monthly mortgage loan payment to pay for the energy improvement. Most of this additional payment is mortgage interest. This additional mortgage interest can be claimed as an itemized deduction on the homeowner's federal and state income tax returns. Furthermore, owners of solar homes are expected to have slightly higher property taxes, which also can be claimed as an itemized deduction on income tax returns. Hence, the cost of increased mortgage loan payments was reduced by these savings on income taxes at the marginal tax rates discussed above.

The additional amounts in monthly mortgage loan payments for energy improvements would largely be offset by savings on monthly utility bills. Given a fixed rate of interest on the mortgage loan, these additional amounts would remain level over time, while the monthly utility bill savings would increase, if utility rates increased or household consumption of hot water increased.

The third type of cost is the periodic expense for maintenance and repair costs for each energy improvement. These expenses are probabilistic in actuality, because they may or may not occur during the period of home ownership. Estimates of these costs are shown below.

Estimates of Maintenance and Repair Costs for Improvements in Energy Efficiency to Heat Water

Ownership Period	High-Efficiency Gas	High-Efficiency Electric	Heat Pump	Solar System
2 years	$0	$0	$0	$0
5 years	$125	$125	$275	$250

It was asumed that maintenance and repair costs would be slightly greater for heat pumps than for solar systems, given that heat pumps have more mechanical components that can fail. For each time period, it was assumed that neither the high-efficiency gas and electric water heaters nor the heat pump and solar water heaters would need replacement. If they were replaced in the first two years, it was assumed that warranties would allow replacement with like units at little or no cost to homeowners.

The net effect of these benefits and costs for the homeowner's pocketbook was calculated as follows:

	Value of tax credit plus interest less taxes thereon
+	Cumulative savings on monthly utility bills
-	Increase in down payment plus foregone interest thereon
-	Sum of increased mortgage loan payments less tax savings
-	Maintenance and repair costs
=	Total net savings for pocketbook

The next two sections present quantitative estimates of the impacts on income to qualify for a mortgage loan (Section D) and the impacts on the homeowner's pocketbook of all benefits and costs (Section E). Although the formulae for computing these estimates (Appendix D) enabled these estimates to be made and reported to the nearest dollar, the assumptions and uncertainties of this study do not warrant this level of precision.

D. Impacts on Income to Qualify for a Mortgage Loan

Table 7 shows how much additional annual family income would have been needed to qualify for the larger mortgage loans to pay for improvements in energy efficiency to heat water in each housing market. For both FHA and conventional mortgage financing, modest amounts of additional annual income would have been necessary (with some exceptions) to finance all energy improvements, as summarized in the table at the top of page 55.

Table 7. Additional Income Needed to Finance Improvements in Energy Efficiency to Heat Water

Average home price ($1,000)	Qualifying gross annual income w/o mandated equipment	High-Efficiency Gas Water Heater: Additional qualifying income with equipment	High-Efficiency Gas Water Heater: Percentage change in qualifying income	High-Efficiency Electric Water Heater: Additional qualifying income with equipment	High-Efficiency Electric Water Heater: Percentage change in qualifying income	Heat Pump Water Heater: Additional qualifying income with equipment	Heat Pump Water Heater: Percentage change in qualifying income	Solar Water Heater: Additional qualifying income with equipment	Solar Water Heater: Percentage change in qualifying income
Affordable Units--Phases 1 and 2									
$96	$32,393	$302	0.9%	$206	0.6%	$635	2.0%	$264	0.8%
$102	$34,409	$302	0.9%	$206	0.6%	$635	1.8%	$196	0.6%
$109	$36,756	$302	0.8%	$206	0.6%	$635	1.7%	$118	0.3%
$118	$39,764	$302	0.8%	$206	0.5%	$635	1.6%	$18	0.0%
$120	$40,446	$302	0.7%	$206	0.5%	$635	1.6%	($4)	0.0%
Market Units--Phase 1									
$189	$63,862	$298	0.5%	$204	0.3%	$627	1.0%	($653)	-1.0%
$208	$64,396	$268	0.4%	$184	0.3%	$565	0.9%	($671)	-1.0%
$235	$75,102	$289	0.4%	$198	0.3%	$608	0.8%	$1,233	1.6%
$248	$79,324	$289	0.4%	$198	0.2%	$608	0.8%	$1,233	1.6%
$265	$84,671	$289	0.3%	$198	0.2%	$608	0.7%	$1,233	1.5%
$279	$89,403	$289	0.3%	$198	0.2%	$608	0.7%	$1,233	1.4%
Market Units--Phase 2									
$265	$81,420	$277	0.3%	$189	0.2%	$583	0.7%	$1,183	1.5%
$279	$85,845	$277	0.3%	$189	0.2%	$583	0.7%	$1,183	1.4%
$297	$91,436	$277	0.3%	$189	0.2%	$583	0.6%	$1,183	1.3%
$317	$97,455	$277	0.3%	$189	0.2%	$583	0.6%	$1,183	1.2%
$333	$102,611	$277	0.3%	$189	0.2%	$583	0.6%	$1,183	1.2%
$340	$104,505	$277	0.3%	$189	0.2%	$583	0.6%	$1,183	1.1%

Additional Annual Family Income Required to Finance Improvements

	FHA		Conventional	
Type of Improvement	Low	High	Low	High
High-efficiency gas	$268	$302	$277	$289
High-efficiency electric	$184	$206	$189	$198
Heat pump	$565	$635	$583	$608
Solar system				
With energy-efficient mortgage	($671)	$264	n/a	n/a
Without energy-efficient mortgage	$1,126	$1,394	$1,183	$1,233

Buyers who purchased solar homes and used FHA's energy-efficient mortgage would have needed from $671 less to $264 more annual income to qualify for the larger mortgage loans to pay for solar systems. Without FHA's energy-efficient mortgage, buyers of solar homes would have needed from $1,126 to $1,394 more annual income to qualify for the larger mortgages required.

Families using conventional financing would have needed from $1,183 to $1,233 more annual income to purchase solar homes. The reason is that Fannie Mae and Freddie Mac have not yet adopted FHA's policy of a one percent stretched ratio to qualify buyers for homes with solar water heating systems in Hawaii. If Fannie Mae and Freddie Mac had adopted FHA's policy, Kumu Iki buyers using conventional financing could have qualified for a solar home with from $1,399 to $2,462 less annual income than would have been needed for a home without a solar system.

Buyers of affordable homes that had other types of energy

improvements would not have been entitled to FHA's more favorable stretched ratios to qualify for the larger mortgage loans to pay for these improvements. FHA contends that the energy savings of these other energy improvements are much smaller than for solar systems, and therefore, do not qualify buyers for stretched ratios. Hence, the additional annual incomes required for standard mortgages on homes with other types of energy improvements would be comparable to or greater than the additional incomes required for energy-efficient mortgages on solar homes.

E. Impacts on the Homeowner's Pocketbook

The impacts of all financial benefits and costs on the homeowner's pocketbook were calculated for four cases (A through D):

Case	Development Phase	Mortgage Rates	Initial Utility Rates	Energy Consumption
A	1	higher	lower	lower
B	1	higher	lower	higher
C	2	lower	higher	lower
D	2	lower	higher	higher

The reader should refer to Section B of this chapter for details on the defintions of "higher" and "lower" mortgage and initial utility rates, and "higher" and "lower" levels of energy consumption. In general, higher mortgage rates and lower initial utility rates occurred when homeowners moved into Phase 1 of Kumu Iki Village in 1990, while lower mortgage rates and higher initial utility rates occurred when they moved into

Phase 2 of Kumu Iki in 1991. The need for lower and higher levels of energy consumption stem from differences in estimates provided by the local gas and electric utilities.

Appendices E and F provide detailed summaries of each type of benefit and cost, together with their net effect on the homeowner's pocketbook, for each of 11 model homes. Appendix E presents this information for property held two years and Appendix F presents this information for property held five years. For affordable and market-priced housing, Table 8 summarizes the net impacts on the homeowner's pocketbook of all benefits and costs for Cases A through D for both two- and five-year home ownership periods.

Several findings are evident from Table 8. First, the net impacts on the homeowner's pocketbook for all cases, housing markets and periods of home ownership are always negative (i.e., cash losses) for high-efficiency gas and electric water heaters and always positive (i.e., cash gains) for heat pumps and solar water heaters. This result reflects the fact that heat pumps and solar systems are entitled to state income tax credits, but high-efficiency gas and electric water heaters are not. Secondly, Table 8 shows that a homeowner would have realized a greater net cash gain over time for a solar system than for a heat pump, because a solar system is entitled to a larger tax credit than a heat pump. These two findings from Table 8 are summarized more concisely in the table at the top of page 59.

Table 8. Cash Gains and Losses of Energy Improvements for Two- and Five-Year Periods

Two-Year Ownership Period

Housing Market	High-Efficiency Gas Water Heater				High-Efficiency Electric Water Heater				Heat Pump Water Heater				Solar Water Heater			
	Case A	Case B	Case C	Case D	Case A	Case B	Case C	Case D	Case A	Case B	Case C	Case D	Case A	Case B	Case C	Case D
Affordable Market	($112)	($96)	($101)	($84)	($47)	($97)	($13)	($38)	$346	$499	$392	$575	$1,248	$1,492	$1,296	$1,577
•Mid-level																
Model IIB	($186)	($170)	($221)	($204)	($98)	($148)	($96)	($121)	$188	$341	$134	$320	$1,244	$1,488	$626	$907
Model IIC	($258)	($242)	($221)	($204)	($147)	($197)	($96)	($121)	$36	$189	$134	$320	$1,244	$1,488	$626	$907
•Upper	($236)	($220)	($221)	($204)	($133)	($183)	($96)	($121)	$83	$236	$134	$320	$561	$805	$626	$907

Five-Year Ownership Period

Housing Market	High-Efficiency Gas Water Heater				High-Efficiency Electric Water Heater				Heat Pump Water Heater				Solar Water Heater			
	Case A	Case B	Case C	Case D	Case A	Case B	Case C	Case D	Case A	Case B	Case C	Case D	Case A	Case B	Case C	Case D
Affordable Market	($306)	($264)	($278)	($231)	($171)	($303)	($81)	($148)	$239	$643	$356	$848	$961	$1,609	$1,090	$1,836
•Mid-level																
Model IIB	($352)	($310)	($358)	($311)	($203)	($335)	($136)	($203)	$134	$538	$180	$672	$1,004	$1,652	$632	$1,378
Model IIC	($415)	($373)	($358)	($311)	($245)	($377)	($136)	($203)	$2	$406	$180	$672	$1,004	$1,652	$632	$1,378
•Upper	($395)	($353)	($358)	($311)	($233)	($365)	($136)	($203)	$42	$446	$180	$672	$463	$1,111	$632	$1,378

Range of Pocketbook Impacts for All Markets and Ownership Periods

	Cash Losses		Cash Gains	
Type of Improvement	Lowest	Highest	Lowest	Highest
High-efficiency gas	$84	$415	none	none
High-efficiency electric	$13	$377	none	none
Heat pump	none	none	$2	$848
Solar system	none	none	$463	$1,836

The remaining findings pertain to heat pump and solar systems, which were the only improvements to provide cash gains, as mentioned previously. For these improvements, one finding is that owners of affordable homes would have realized greater cash gains than would owners of market-priced homes, as shown in the table below. This occurs because the down payment requirements for affordable homes under FHA financing are much less than they are under conventional financing for market-priced homes. Hence, with FHA financing a greater portion of the cost of the improvement is included in the mortgage loan and paid back over the life of the loan.

	Range in Cash Gains			
	Affordable Homes		Market-Priced Homes	
Type of Improvement	Lowest	Highest	Lowest	Highest
Heat pump	$239	$848	$2	$672
Solar system	$961	$1,836	$463	$1,652

Another finding is that the size and range of cash gains for heat

pump and solar water heaters are related to the length of home ownership. With longer home ownership, cash gains would either decline or increase depending upon which case (A through D) applies. As ownership stretched from two to five years, some homeowners would have seen lower cash gains under Case A (i.e., higher mortgage rates, and lower initial utility and energy consumption rates), but other homeowners would have seen higher cash gains under Case D (i.e., lower mortgage rates, and higher initial utility and energy consumption rates). This result is also due to the uncertainty regarding actual energy consumption levels, as shown below.

Range in Cash Gains

	Two-Year Period		Five-Year Period	
Type of Improvement	Lowest	Highest	Lowest	Highest
Heat pump	$36	$575	$2	$848
Solar system	$561	$1,577	$463	$1,836

Finally, a homeowner's cash gains would have been greater under the higher level of household energy use (Cases B and D) than under the lower level (Cases A and C). However, even when lower energy use per household was assumed, homeowners with heat pumps or solar systems would still have realized net pocketbook gains. The table on the next page shows these findings in terms of the range of cash gains for lower and higher levels of energy use.

	Range in Cash Gains			
	Lower Energy Use		Higher Energy Use	
Type of Improvement	Lowest	Highest	Lowest	Highest
Heat pump	$2	$392	$189	$848
Solar system	$463	$1,296	$805	$1,836

In summary, if the state had required installation of energy improvements at Kumu Iki Village, then homeowners with solar water heating systems would have realized the largest net cash gains over time, when compared to those in identical homes with other types of improvements in energy efficiency to heat water. The cash gains for solar systems are greatest for owners of affordable homes, primarily because the down payment requirements under FHA financing are lower for affordable homes compared to market-priced homes. However, cash gains for solar systems are still substantial for homeowners in both housing markets, even if homes are owned for only two years and the family has a lower level of energy consumption.

Chapter IV

Summary of Findings, Conclusions, Recommendations

A. Summary of Findings

The findings of this study are different for Kumu Iki's two different housing markets:

1. Affordable Homes

This study has shown that, if solar water heating systems had been installed in Phases 1 and 2 of Kapolei's Kumu Iki Village, then buyers of its affordable homes would have needed at most $264 of additional annual income to qualify for the energy-efficient mortgages needed to finance solar homes. Without FHA's energy-efficient mortgage, buyers of solar homes would have needed from $1,126 to $1,394 more annual income to qualify for the larger mortgages required. Those who purchased affordable homes equipped with other types of energy improvements (i.e., heat pump water heaters and high-efficiency gas and electric water heaters) would have needed from $206 to $635 more annual income, depending upon the type of improvement, to qualify for a standard FHA mortgage. Homes with these other types of improvements do not qualify buyers for FHA's energy-efficient mortgages. Because the requirement for additional income is marginal for each improvement, it could be offset by compensating factors (e.g., the borrower's employment security and good credit rating).

Owners of affordable homes with either solar systems or heat pumps would have realized net cash gains during the period of home ownership. These cash gains vary depending upon assumptions about utility rates, levels of home energy consumption, mortgage financing rates, and the homeowner's tax bracket. The cash gains for solar systems range from $1,248 to $1,577, if the home was owned for two years, and from $961 to $1,836, if it was owned for five years. Compared to owners of solar systems, those who had affordable homes equipped with heat pump water heaters would have realized smaller net cash gains that range from $346 to $575, if the home was owned for two years, and from $239 to $848, if it was owned for five years. These cash gains occur because the two benefits of these systems exceed their costs. These benefits are: (1) the state income tax credits, which are 35 percent of the actual cost of a solar system and 20 percent of the cost of a heat pump; and (2) the accrued savings on monthly utility bills.

Those who owned affordable homes with high-efficiency gas or electric water heaters would have realized net cash losses, which also vary depending upon assumptions about utility rates, levels of home energy consumption, mortgage financing rates, and the homeowner's tax bracket. The cash losses for high-efficiency gas water heaters range from $84 to $112, if the home was owned for two years, and from $231 to $306, if the home was held for five years. The cash losses for high-efficiency electric water heaters range from $13 to $97, if the home was owned for two years, and from $81 to $303, if the home was held for five years. Cash losses occur for these water heaters, because their costs exceed cumulative

savings on utility bills, and because homeowners can not claim tax credits for them under present state law.

2. Market-Priced Homes

It was assumed that most market-priced homes at Kumu Iki, except for lower priced models for sale in Phase 1, were purchased with conventional mortgage financing. Although energy-efficient mortgages exist for conventional financing, they have not yet been tailored to the Hawaii housing market. Buyers of Kumu Iki's market-priced homes would have needed more income to qualify for homes with conventional financing regardless of which energy improvement was installed, as shown in the table below.

Additional Annual Income Required for Conventional Financing

Type of Improvement	Installed Cost	Year of Purchase 1990	1991
High-efficiency gas	$950	$289	$277
High-efficiency electric	$650	$198	$189
Heat pump	$2,000	$608	$583
Solar system	$4,000	$1,233	$1,183

This table also shows that the additional annual income required depends primarily upon the cost of the improvement. Solar systems, which are the most expensive improvement, require the most additional income to qualify for the mortgage. On the other hand, high-efficiency

electric water heaters require the least additional income, because they are the least expensive of the energy improvements. The amount of additional income required also depends upon the mortgage financing rates, which varied from the higher rate (10.125 percent) assumed for 1990 to the lower rate (9.625 percent) for 1991. The table also shows that slightly more income would have been needed for each improvement in 1990 than in 1991, because mortgage rates were higher in 1990 than in 1991.

Buyers of market-priced homes may or may not have realized positive cash gains over time, depending upon which type of energy improvement they had. For these homes, only heat pumps and solar systems would have provided positive cash gains for all cases and time periods and high-efficiency gas and electric water heaters would have imposed cash losses for all cases and time periods, as shown in the table below.

Range of Pocketbook Impacts for Market-Priced Homes

	Cash Losses		Cash Gains	
Type of Improvement	Lowest	Highest	Lowest	Highest
High-efficiency gas	$170	$415	none	none
High-efficiency electric	$96	$377	none	none
Heat pump	none	none	$2	$672
Solar system	none	none	$463	$1,652

B. Conclusions

This study has shown that home buyers would benefit substantially if they linked energy-efficient mortgages for solar water heating systems

with state energy income tax credits for solar systems. Specifically, it has shown that new homes with HUD-approved solar systems are affordable when buyers use FHA's energy-efficient mortgage and that these systems return positive dividends during home ownership.

Savings on utility bills and the current state income tax credits under Act 319, *Session Laws of Hawaii*, 1990, are the reasons why families in Kapolei's Kumu Iki Village would have realized net cash gains, if they had been given an opportunity to purchase homes with heat pumps or HUD-approved solar water heating systems. Without the tax credits, the estimated cash gains from owning heat pump and solar water heating systems would either disappear or would have to be scaled back substantially. Kumu Iki home buyers would have realized net cash losses, however, if they had purchased homes with high-efficiency gas or electric water heaters. These losses occur because these systems do not save homeowners enough money on utility bills to outweigh their added costs and because tax credits for these systems do not exist.

The conclusions of this report are based on a case study of buyers who purchased homes in Kumu Iki Village at Kapolei in 1990 and 1991. Since these homes were not equipped with energy efficiency improvements in water heating, one must ask: Will these conclusions apply to buyers of homes in state projects mandated by Act 255, *Session Laws of Hawaii*, 1992, to be equipped with energy improvements in the future? No doubt the actual financial impacts of energy improvements on future home buyers will be different than the hypothetical impacts that were determined for home buyers in the past. Nevertheless, the basic conclusions of

the study are expected to hold at least in the near future, because the principal economic factors and conditions that affect these conclusions are not expected to change much during the next several years. These factors and conditions primarily include home prices, the installed costs of energy improvements and their repair costs, utility rates, interest rates on mortgage loans, interest rates on savings accounts, and property tax rates.

C Recommendations

Since the results of this study are not intuitive, state energy and housing officials should inform and educate Hawaii's home builders, real estate brokers, lenders and home buyers of the opportunities afforded them by energy-efficient mortgages and state energy income tax credits. Also, the state should urge Fannie Mae and Freddie Mac to adopt FHA's policy and grant a one percent increase in both the total debt-to-income ratio and the house payment-to-income ratio for buyers who purchase solar homes in Hawaii. That adoption could enable buyers using conventional financing to qualify for solar homes with less income than would be needed for homes without solar systems.

The state should encourage primary lenders to reduce loan points as an incentive to home buyers to use energy-efficient mortgages. The state should also explore whether lenders would allow buyers to purchase homes with other types of home energy improvements (besides solar water heating systems) and allow buyers to qualify for the larger mortgages needed to pay for these improvements without having substantially more income. These improvements could include more efficient

ventilation systems, radiant barriers, light colored finishes on roofs and exterior walls to reflect sunlight, and energy-efficient major appliances and lighting. Lenders may be receptive to this idea, if the state developed and required a home energy rating system. Such a system would minimize the uncertainty surrounding the energy savings of these home improvements.

This study confronted several uncertainties that should be resolved by future research. First, the state should encourage local utilities to improve end-use data for water heaters. The utilities disagree over how much energy is used in homes to heat water. Better end-use data on water heating would allow more accurate estimates of the financial impacts on homeowners who invest in improvements in energy efficiency to heat water. Second, it is not clear yet whether the full cost of a solar system can be included in the mortgage loan. That decision depends on how a solar system affects the appraised property value of the home, particularly when all homes in a subdivision are equipped with solar systems. Presently, there is no precedent for that situation on Oahu. Third, there is uncertainty over the actual costs to home buyers of energy efficiency improvements that are installed on a volume basis in an entire subdivision. Fourth, the Energy Policy Act of 1992 establishes provisions for a uniform energy-efficient mortgage program and a pilot program in five states. The impacts and significance of this program for Hawaii will remain unclear until the federal government expands the program nationwide.

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Appendix A

Energy Addendum

ENERGY ADDENDUM

FILE NO.

This energy addendum is a two-part optional report designed to assist lenders in underwriting energy-efficient properties. Each part has a particular use, and the parts are to be treated as separate reports.

Part 1 of this addendum is for rating the energy efficiency of the subject property. It must be completed by an energy consultant or an appraiser. An energy-efficient rating of "high" is required to justify additional consideration in the credit underwriting process.

Part 2 of this addendum is for estimating the value of energy-efficient items only when adequate comparable market data are not available. It must be completed by an appraiser.

Borrower: _____

Property Address:

Part 1—Energy checklist

In this section, the energy consultant or appraiser should note the energy-efficient characteristics of the subject property and use these characteristics as a basis for rating the property's overall energy efficiency (high, adequate, or low). Generally, a dwelling should contain energy-efficient features for insulation, windows and doors, and heating and cooling to receive a "high" rating.

The comments sections should be used to describe the specific features and the quality and adequacy of the installation of the energy-efficient item(s) or technique(s). For example, if the energy-efficient furnace box is checked in the heating and cooling section below, those features that make the furnace "energy efficient" should be explained. In addition, the estimated monthly savings* from the energy-efficient items should be noted (*not required by Fannie Mae). The estimated monthly savings should be calculated as follows:

- for existing homes: the actual dollar difference between the current energy costs for an existing item and the estimated energy costs for the proposed energy-efficient item or the actual dollar difference between the current energy costs for an existing energy-efficient item and the estimated energy costs for whatever is prevalent for that item in the subject neighborhood ("neighborhood norm").
- for new homes: the actual dollar difference between the energy costs of the builder's base item and the estimated energy costs of the proposed energy-efficient item (if no base exists with which to compare, the base would be the neighborhood norm).

A. Insulation (check if present, state "R" value if known)

- ☐ Attic/roof: R- _____
- ☐ Ceiling: R- _____
- ☐ Exterior walls: R- _____
- ☐ Floors: R- _____
- ☐ Slab/perimeter: R- _____
- ☐ Foundation walls: R- _____
- ☐ Insulated water heater ☐ Insulation wrap: R- _____
- ☐ Insulated heat/cooling ducts or pipes: R- _____

Comments (describe quality and adequacy): _____

*Estimated monthly savings $

B. Windows and doors

- ☐ Double (storm)/triple glazed windows
- ☐ Storm doors: On _____ of _____ doors
- ☐ Insulated doors
- ☐ Weatherstripping
- ☐ Caulking
- ☐ Other: _____

Comments (describe quality and adequacy): _____

*Estimated monthly savings $

C. Heating and cooling

1. Conventional equipment

- ☐ Automatic setback thermostat
- ☐ Automatic flue damper
- ☐ Energy-efficient furnace
- ☐ Energy-efficient air conditioner
- ☐ Energy-efficient heat pump
- ☐ Energy-efficient hot water heater
- ☐ Special fireplace devices/features (describe in comments)
- ☐ Wood burning stove
- ☐ Outside combustion air for fireplace or woodstove
- ☐ Other: _____

Efficient heating and cooling systems include such things as a high efficiency oil or gas furnace with an Annual Fuel Utilization Efficiency (AFUE) rating of 80% or higher, a high efficiency heat pump with a Seasonal Energy Efficiency Ratio (SEER) measure of 9.0 or greater and a Heating Seasonal Performance Factor (HSPF) of 7.0 or greater, and a central air conditioner with a SEER rating of 9.0 or greater.

Energy-efficient modifications to an existing system include such things as a flame retention oil burner, vent dampers for oil and gas furnaces, pilotless ignition for gas furnaces, and a secondary condensing heat exchanger for gas and oil furnaces.

Comments (describe quality and adequacy): _____

*Estimated monthly savings $

2. Solar equipment or design

- ☐ Passive solar design/landscaping—exterior (describe features below)
- ☐ Passive solar design—interior (describe features below)
- ☐ Solar space heating/cooling
- ☐ Back-up heating/cooling system
- ☐ Solar electric panels
- ☐ Solar hot water heating
- ☐ Earth-sheltered housing design
- ☐ Other: _____

Comments (describe quality and adequacy): _____

*Estimated monthly savings $

Energy rating

Has an energy audit/rating been performed on the subject property?
☐ Yes (attach, if available) ☐ No ☐ Unknown

Energy efficiency appears:
☐ High ☐ Adequate ☐ Low

Comments: (including sources of above data and specifications) _____

*Total estimated monthly savings of energy-efficient features $ _____

SIGNATURE _____ COMPANY NAME _____

NAME _____ DATE _____

Part 2—Estimate of value of energy-efficient items

This section can be used to help estimate the value of energy-efficient items only when adequate comparable market data are not available.

In such cases, the value of the energy-efficient items should be the lesser of

(a) the present worth of the estimated savings in utility costs, as determined by capitalizing the savings at an interest rate that is not less than the current interest rate for home mortgages for a period that does not exceed the lesser of the item's expected physical life or seven years, or

(b) the installed cost of the energy-efficient item or construction technique, less any physical, functional, and external depreciation.

For example, if the subject property is an existing house with inadequate insulation and infiltration barriers—such as one without storm windows, caulking, and weatherstripping—and the estimated savings per month is $35 for upgrading the property (based on an energy audit/rating), the appraiser could use the following calculations as a guide.

Installed cost (less depreciation)	$2,500	
Expected life	7 + years	
Expected monthly savings	$35 per month	**$420 x 4.789 = $2,011.38**
Expected annual savings	$420 per year	
Present value factor (annual compound interest at 10.5% for 7 years)	4.789	

For this example, it would appear reasonable **(only if adequate comparable data were not available)** that a typical purchaser might pay a premium of $2,000 for the property as improved with the suggested energy-related items.

Value calculations (Use additional forms if more than three items)

1. Description of item or construction technique _____

Estimated monthly savings $ _____ Expected life: _____ years

Source(s) of savings estimate: _____

Use this space to show all calculations

a. Present worth of estimated savings . . . . . $ _____

b. Installed cost of item or technique (less any depreciation) . . . . . $ _____

Estimated value of item (the lesser of a or b) . . . . . $ _____ (1)

2. Description of item or construction technique _____

Estimated monthly savings $ _____ Expected life: _____ years

Source(s) of savings estimate: _____

Use this space to show all calculations

a. Present worth of estimated savings . . . . . $ _____

b. Installed cost of item or technique (less any depreciation) . . . . . $ _____

Estimated value of item (the lesser of a or b) . . . . . $ _____ (2)

3. Description of item or construction technique _____

Estimated monthly savings $ _____ Expected life: _____ years

Source(s) of savings estimate: _____

Use this space to show all calculations

a. Present worth of estimated savings . . . . . $ _____

b. Installed cost of item or technique (less any depreciation) . . . . . $ _____

Estimated value of item (the lesser of a or b) . . . . . $ _____ (3)

Estimated total value of item(s) or technique(s) (the sum of (1), (2), and (3) above) . . . . . $ _____

I have used acceptable valuation methodology in this analysis to estimate the present worth of the items and techniques contributing to the energy efficiency of the property. The results are subject to variance based on the effective use and maintenance of the items and the lifestyle of the occupants of the property.

Appraiser SIGNATURE _____ COMPANY NAME _____

NAME _____ DATE _____

Appendix B

Solar Water Heating Systems Approved by the U.S. Department of Housing and Urban Development

Source: Circular Letter #91-01, U.S. Department of Housing and Urban Development, Honolulu, Hawaii, November 30, 1990.

Solar Manufacturer	Collector Model No.	Maximum Cost [a]
Calwest Energy Services, Inc. Palos Verdes Estates, CA 90274	SL-3810A-BC 24 ft^2	$3,240
	SL-41010A-BC 40 ft^2	$3,000-$4,200
Fafco, Inc. Menlo Park, CA 91304	Fafco 444-A 37.5 ft^2	$2,920-$4,050
Heliodyne, Inc. Richmond, CA 94804	Heliodyne "Gobi" 32 ft^2	$2,760-$3,720
	Heliodyne "Gobi" 40 ft^2	$3,000-$4,200
Morning Star Mfrg., Inc. Stanton, CA 90680	CSC 26 26 ft^2	$3,360-$4,140
	CSC 48 48 ft^2	$3,240-$4,680

a. Price varies depending upon the number of panels in the solar system.

Solar Manufacturer	Collector Model No.	Maximum Cost [a]
Radco Products, Inc. Santa Maria, CA 93455	41DC-HP 39.9 ft^2	$3,000-$4,200
	412C-HP 48.3 ft^2	$3,250-$4,700
Solarhart USA San Diego, CA 92121	30DJK & JD 21.4 ft^2	$3,100-$3,740
	80GE 21.4 ft^2	$3,100-$3,740
Solar Transition, Inc. Escondido, CA 92025	P40 & HP 408 32 ft^2	$2,760-$3,720
	P412 HP412 48 ft^2	$3,240 $4,680
Solcoor, Inc. Van Nuys, CA 91406	LSC - D 21.9 ft^2	$3,100
	LSC - E 25.3 ft^2	$3,320
	LSC-F5 28.9 ft^2	$2,690-$3,580
	LSC-A5 40.6 ft^2	$3,020-$4,240

a. Price varies depending upon the number of panels in the solar system.

Solar Manufacturer	Collector Model No.	Maximum Cost [a]
Sunearth of California Santa Rosa, CA 95401	EMB 38 EMC 38 24.8 ft^2	$3,290-$4,030
	EMC 48 33 ft^2	$2,790-$4,770
	SE-40 & EMB 410 EMC 410 40 ft^2	$3,000 $4,200
Sun Resource Systems Sylmar, CA 91342	SLRF 388C 24 ft^2	$3,240
	SLRF 48P SLRF 48BC 33.5 ft^2	$2,800 $3,810
	SLRF 410P SLRF 4108C 41.7 ft^2	$3,050 $4,300
The Amcor Group, Ltd. Conoga Park, CA 90680	S-150 30 ft^2	$2,700-$4,500
	Solon-240 25.8 ft^2	$3,340-$4,110

a. Price varies depending upon the number of panels in the solar system.

Solar Manufacturer	Collector Model No.	Maximum Cost [a]
U.S. Solar Corp. Hampton, Florida 32044	CF-SGC 32 ft^2	$2,760-$3,720
	CF-SGC 40 ft^2	$3,000-$4,200
	CF-SGC 52 ft^2	$3,300-$4,800

a. Price varies depending upon the number of panels in the solar system.

Appendix C

Detailed Calculations on Mortgage Loans for Homes with and without Energy Improvements in Phase 1 of Kumu Iki Village at Kapolei

NOTE: The calculations in this appendix are based on "high" estimates of monthly home energy consumption, as given in Table 4. Although numbers in this appendix are shown to the nearest penny, they should not be construed as precise figures, because of the necessary assumptions underlying the calculations.

Model IA: Ku'u Pomaika'i

Description: 2 bedrooms, 2 baths, $96,000 home

Financing: Hula Mae/FHA 30-year mortgage @ 8.625% with 5% down and 1 point

	Standard Water Heater	*High-Efficiency Gas Water Heater*	*High-Efficiency Electric Water Heater*	*Heat Pump Water Heater*	*Solar Water Heater*
Base home price	$96,000.00	$96,000.00	$96,000.00	$96,000.00	$96,000.00
Cost of energy improvement		$950.00	$650.00	$2,000.00	
Closing costs	$1,500.00	$1,500.00	$1,500.00	$1,500.00	$1,500.00
Total price for home	$97,500.00	$98,450.00	$98,150.00	$99,500.00	$97,500.00
Down payment	$4,375.00	$4,422.50	$4,407.50	$4,475.00	$4,375.00
1 point paid by buyer	$966.64	$976.01	$973.05	$986.36	$1,008.16
Down payment + points	$5,341.64	$5,398.51	$5,380.55	$5,461.36	$5,383.16
Base loan	$93,125.00	$94,027.50	$93,742.50	$95,025.00	$93,125.00
Cost of energy improvement					$4,000.00
FHA mortgage insurance	$3,538.75	$3,573.05	$3,562.22	$3,610.95	$3,690.75
Mortgage loan	$96,663.75	$97,600.55	$97,304.72	$98,635.95	$100,815.75
Embedded loan for improvement		$902.50	$617.50	$1,900.00	$4,000.00
Appraised home value	$96,000.00	$96,000.00	$96,000.00	$96,000.00	$100,000.00
Monthly P&I @ 8.625%	$751.85	$759.14	$756.84	$767.19	$784.14
Monthly taxes & insurance	$30.98	$30.98	$30.98	$30.98	$32.27
Monthly PITI*	$782.83	$790.12	$787.82	$798.17	$816.42
Monthly utilities	$78.93	$74.96	$77.47	$59.18	$50.87
Monthly PITI* + utilities	$861.76	$865.08	$865.28	$857.36	$867.29
Qualifying gross annual income	$32,393.07	$32,694.57	$32,599.36	$33,027.81	$32,656.70
Ratio (PITI* as % of income)	29%	29%	29%	29%	30%
Evaluation					
Additional annual income needed for loan		**$301.51**	**$206.29**	**$634.75**	**$263.64**
% change in qualifying income		**0.9%**	**0.6%**	**2.0%**	**0.8%**
Additional down payment		**$56.87**	**$38.91**	**$119.72**	**$41.52**
Additional PITI*		**$7.29**	**$4.99**	**$15.34**	**$33.59**

* Principal, interest, taxes, and insurance

Model IB: Ku'u Mana'olana

Description: 3 bedrooms, 2 baths, $102,000 home

Financing: Hula Mae/FHA 30-year mortgage @ 8.625% with 5% down and 1 point

	Standard Water Heater	*High-Efficiency Gas Water Heater*	*High-Efficiency Electric Water Heater*	*Heat Pump Water Heater*	*Solar Water Heater*
Base home price	$102,000.00	$102,000.00	$102,000.00	$102,000.00	$102,000.00
Cost of energy improvement		$950.00	$650.00	$2,000.00	
Closing costs	$1,600.00	$1,600.00	$1,600.00	$1,600.00	$1,600.00
Total price for home	$103,600.00	$104,550.00	$104,250.00	$105,600.00	$103,600.00
Down payment	$4,680.00	$4,727.50	$4,712.50	$4,780.00	$4,680.00
1 point paid by buyer	$1,026.79	$1,036.16	$1,033.20	$1,046.51	$1,068.31
Down payment + points	$5,706.79	$5,763.66	$5,745.70	$5,826.51	$5,748.31
Base loan	$98,920.00	$99,822.50	$99,537.50	$100,820.00	$98,920.00
Cost of energy improvement					$4,000.00
FHA mortgage insurance	$3,758.96	$3,793.26	$3,782.43	$3,831.16	$3,910.96
Mortgage loan	$102,678.96	$103,615.76	$103,319.93	$104,651.16	$106,830.96
Embedded loan for improvement		$902.50	$617.50	$1,900.00	$4,000.00
Appraised home value	$102,000.00	$102,000.00	$102,000.00	$102,000.00	$106,000.00
Monthly P&I @ 8.625%	$798.64	$805.92	$803.62	$813.98	$830.93
Monthly taxes & insurance	$32.92	$32.92	$32.92	$32.92	$34.21
Monthly PITI*	$831.56	$838.84	$836.54	$846.89	$865.14
Monthly utilities	$78.93	$74.96	$77.47	$59.18	$50.87
Monthly PITI* + utilities	$910.49	$913.80	$914.01	$906.08	$916.01
Qualifying gross annual income	$34,409.18	$34,710.68	$34,615.47	$35,043.92	$34,605.61
Ratio (PITI* as % of income)	29%	29%	29%	29%	30%
Evaluation					
Additional annual income needed for loan		**$301.51**	**$206.29**	**$634.75**	**$196.43**
% change in qualifying income		**0.9%**	**0.6%**	**1.8%**	**0.6%**
Additional down payment		**$56.87**	**$38.91**	**$119.72**	**$41.52**
Additional PITI*		**$7.29**	**$4.99**	**$15.34**	**$33.59**

* Principal, interest, taxes, and insurance

Model IC: Ku'u Mele

Description: 3 bedrooms, 2.5 baths, $109,000 home

Financing: Hula Mae/FHA 30-year mortgage @ 8.625% with 5% down and 1 point

	Standard Water Heater	*High-Efficiency Gas Water Heater*	*High-Efficiency Electric Water Heater*	*Heat Pump Water Heater*	*Solar Water Heater*
Base home price	$109,000.00	$109,000.00	$109,000.00	$109,000.00	$109,000.00
Cost of energy improvement		$950.00	$650.00	$2,000.00	
Closing costs	$1,700.00	$1,700.00	$1,700.00	$1,700.00	$1,700.00
Total price for home	$110,700.00	$111,650.00	$111,350.00	$112,700.00	$110,700.00
Down payment	$5,035.00	$5,082.50	$5,067.50	$5,135.00	$5,035.00
1 point paid by buyer	$1,096.80	$1,106.17	$1,103.21	$1,116.52	$1,138.32
Down payment + points	$6,131.80	$6,188.67	$6,170.71	$6,251.52	$6,173.32
Base loan	$105,665.00	$106,567.50	$106,282.50	$107,565.00	$105,665.00
Cost of energy improvement					$4,000.00
FHA mortgage insurance	$4,015.27	$4,049.57	$4,038.74	$4,087.47	$4,167.27
Mortgage loan	$109,680.27	$110,617.07	$110,321.24	$111,652.47	$113,832.27
Embedded loan for improvement		$902.50	$617.50	$1,900.00	$4,000.00
Appraised home value	$109,000.00	$109,000.00	$109,000.00	$109,000.00	$113,000.00
Monthly P&I @ 8.625%	$853.09	$860.38	$858.08	$868.43	$885.39
Monthly taxes & insurance	$35.18	$35.18	$35.18	$35.18	$36.47
Monthly PITI*	$888.27	$895.56	$893.26	$903.61	$921.86
Monthly utilities	$78.93	$74.96	$77.47	$59.18	$50.87
Monthly PITI* + utilities	$967.20	$970.52	$970.72	$962.79	$972.73
Qualifying gross annual income	$36,756.01	$37,057.52	$36,962.31	$37,390.76	$36,874.22
Ratio (PITI* as % of income)	29%	29%	29%	29%	30%
Evaluation					
Additional annual income needed for loan		**$301.51**	**$206.29**	**$634.75**	**$118.21**
% change in qualifying income		**0.8%**	**0.6%**	**1.7%**	**0.3%**
Additional down payment		**$56.87**	**$38.91**	**$119.72**	**$41.52**
Additional PITI*		**$7.29**	**$4.99**	**$15.34**	**$33.59**

* Principal, interest, taxes, and insurance

Model ID: Ku'u Kauhale

Description: 3 bedrooms, 2.5 baths, $118,000 home

Financing: Hula Mae/FHA 30-year mortgage @ 8.625% with 5% down and 1 point

	Standard Water Heater	*High-Efficiency Gas Water Heater*	*High-Efficiency Electric Water Heater*	*Heat Pump Water Heater*	*Solar Water Heater*
Base home price	$118,000.00	$118,000.00	$118,000.00	$118,000.00	$118,000.00
Cost of energy improvement		$950.00	$650.00	$2,000.00	
Closing costs	$1,800.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
Total price for home	$119,800.00	$120,750.00	$120,450.00	$121,800.00	$119,800.00
Down payment	$5,490.00	$5,537.50	$5,522.50	$5,590.00	$5,490.00
1 point paid by buyer	$1,186.54	$1,195.91	$1,192.95	$1,206.26	$1,228.06
Down payment + points	$6,676.54	$6,733.41	$6,715.45	$6,796.26	$6,718.06
Base loan	$114,310.00	$115,212.50	$114,927.50	$116,210.00	$114,310.00
Cost of energy improvement					$4,000.00
FHA mortgage insurance	$4,343.78	$4,378.08	$4,367.25	$4,415.98	$4,495.78
Mortgage loan	$118,653.78	$119,590.58	$119,294.75	$120,625.98	$122,805.78
Embedded loan for improvement		$902.50	$617.50	$1,900.00	$4,000.00
Appraised home value	$118,000.00	$118,000.00	$118,000.00	$118,000.00	$122,000.00
Monthly P&I @ 8.625%	$922.89	$930.18	$927.87	$938.23	$955.18
Monthly taxes & insurance	$38.08	$38.08	$38.08	$38.08	$39.37
Monthly PITI*	$960.97	$968.26	$965.96	$976.31	$994.56
Monthly utilities	$78.93	$74.96	$77.47	$59.18	$50.87
Monthly PITI* + utilities	$1,039.90	$1,043.22	$1,043.42	$1,035.49	$1,045.43
Qualifying gross annual income	$39,764.31	$40,065.82	$39,970.60	$40,399.06	$39,782.24
Ratio (PITI* as % of income)	29%	29%	29%	29%	30%
Evaluation					
Additional annual income needed for loan		**$301.51**	**$206.29**	**$634.75**	**$17.93**
% change in qualifying income		**0.8%**	**0.5%**	**1.6%**	**0.0%**
Additional down payment		**$56.87**	**$38.91**	**$119.72**	**$41.52**
Additional PITI*		**$7.29**	**$4.99**	**$15.34**	**$33.59**

* Principal, interest, taxes, and insurance

Model IIA: Ku'u Kunana

Description: 2 bedrooms, 2 baths, $120,000 home

Financing: Hula Mae/FHA 30-year mortgage @ 8.625% with 5% down and 1 point

	Standard Water Heater	*High-Efficiency Gas Water Heater*	*High-Efficiency Electric Water Heater*	*Heat Pump Water Heater*	*Solar Water Heater*
Base home price	$120,000.00	$120,000.00	$120,000.00	$120,000.00	$120,000.00
Cost of energy improvement		$950.00	$650.00	$2,000.00	
Closing costs	$1,800.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
Total price for home	$121,800.00	$122,750.00	$122,450.00	$123,800.00	$121,800.00
Down payment	$5,590.00	$5,637.50	$5,622.50	$5,690.00	$5,590.00
1 point paid by buyer	$1,206.26	$1,215.63	$1,212.67	$1,225.98	$1,247.78
Down payment + points	$6,796.26	$6,853.13	$6,835.17	$6,915.98	$6,837.78
Base loan	$116,210.00	$117,112.50	$116,827.50	$118,110.00	$116,210.00
Cost of energy improvement					$4,000.00
FHA mortgage insurance	$4,415.98	$4,450.28	$4,439.45	$4,488.18	$4,567.98
Mortgage loan	$120,625.98	$121,562.78	$121,266.95	$122,598.18	$124,777.98
Embedded loan for improvement		$902.50	$617.50	$1,900.00	$4,000.00
Appraised home value	$120,000.00	$120,000.00	$120,000.00	$120,000.00	$124,000.00
Monthly P&I @ 8.625%	$938.23	$945.52	$943.21	$953.57	$970.52
Monthly taxes & insurance	$38.73	$38.73	$38.73	$38.73	$40.02
Monthly PITI*	$976.96	$984.24	$981.94	$992.30	$1,010.54
Monthly utilities	$78.93	$74.96	$77.47	$59.18	$50.87
Monthly PITI* + utilities	$1,055.89	$1,059.21	$1,059.41	$1,051.48	$1,061.42
Qualifying gross annual income	$40,425.77	$40,727.27	$40,632.06	$41,060.52	$40,421.65
Ratio (PITI* as % of income)	29%	29%	29%	29%	30%
Evaluation					
Additional annual income needed for loan		**$301.51**	**$206.29**	**$634.75**	**($4.12)**
% change in qualifying income		**0.7%**	**0.5%**	**1.6%**	**0.0%**
Additional down payment		**$56.87**	**$38.91**	**$119.72**	**$41.52**
Additional PITI*		**$7.29**	**$4.99**	**$15.34**	**$33.59**

* Principal, interest, taxes, and insurance

Model IIB: Ku'u Kamali'i

Description: 3 bedrooms, 2 baths, $189,170 home

Financing: FHA 30-year mortgage @ 9.5% with 14% down and 3 points

	Standard Water Heater	*High-Efficiency Gas Water Heater*	*High-Efficiency Electric Water Heater*	*Heat Pump Water Heater*	*Solar Water Heater*
Base home price	$189,170.00	$189,170.00	$189,170.00	$189,170.00	$189,170.00
Cost of energy improvement		$950.00	$650.00	$2,000.00	
Closing costs	$2,400.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
Total price for home	$191,570.00	$192,520.00	$192,220.00	$193,570.00	$191,570.00
Down payment	$24,069.80	$24,202.80	$24,160.80	$24,349.80	$24,069.80
2 points paid by buyer	$3,510.80	$3,527.93	$3,522.52	$3,546.86	$3,594.64
Down payment + points	$27,580.60	$27,730.73	$27,683.32	$27,896.66	$27,664.44
Base loan	$167,500.20	$168,317.20	$168,059.20	$169,220.20	$167,500.20
Cost of energy improvement					$4,000.00
FHA mortgage insurance	$6,365.01	$6,396.05	$6,386.25	$6,430.37	$6,517.01
1 point origination fee	$1,675.00	$1,683.17	$1,680.59	$1,692.20	$1,715.00
Mortgage loan	$175,540.21	$176,396.43	$176,126.04	$177,342.77	$179,732.21
Embedded loan for improvement		$817.00	$559.00	$1,720.00	$4,000.00
Appraised home value	$189,170.00	$189,170.00	$189,170.00	$189,170.00	$193,170.00
Monthly P&I @ 9.5%	$1,476.04	$1,483.24	$1,480.96	$1,491.19	$1,511.29
Monthly taxes & insurance	$67.29	$67.29	$67.29	$67.29	$68.94
Monthly PITI*	$1,543.32	$1,550.52	$1,548.25	$1,558.48	$1,580.22
Monthly utilities	$78.93	$74.96	$77.47	$59.18	$50.87
Monthly PITI* + utilities	$1,622.25	$1,625.48	$1,625.71	$1,617.66	$1,631.10
Qualifying gross annual income	$63,861.60	$64,159.51	$64,065.43	$64,488.78	$63,208.89
Ratio (PITI* as % of income)	29%	29%	29%	29%	30%
Evaluation					
Additional annual income needed for loan		**$297.91**	**$203.83**	**$627.18**	**($652.70)**
% change in qualifying income		**0.5%**	**0.3%**	**1.0%**	**-1.0%**
Additional down payment		**$150.12**	**$102.72**	**$316.05**	**$83.84**
Additional PITI*		**$7.20**	**$4.93**	**$15.16**	**$36.90**

* Principal, interest, taxes, and insurance

Model IIC: Ku'u Hau'oli

Description: 3 bedrooms, 2.5 baths, $208,180 home

Financing: FHA 30-year mortgage @ 9.5% with 22.5% down and 3 points

	Standard Water Heater	*High-Efficiency Gas Water Heater*	*High-Efficiency Electric Water Heater*	*Heat Pump Water Heater*	*Solar Water Heater*
Base home price	$208,180.00	$208,180.00	$208,180.00	$208,180.00	$208,180.00
Cost of energy improvement		$950.00	$650.00	$2,000.00	
Closing costs	$2,400.00	$2,400.00	$2,400.00	$2,400.00	$2,400.00
Total price for home	$210,580.00	$211,530.00	$211,230.00	$212,580.00	$210,580.00
Down payment	$42,505.50	$42,719.25	$42,651.75	$42,955.50	$42,505.50
2 points paid by buyer	$3,522.84	$3,538.27	$3,533.40	$3,555.33	$3,606.68
Down payment + points	$46,028.34	$46,257.52	$46,185.15	$46,510.83	$46,112.18
Base loan	$168,074.50	$168,810.75	$168,578.25	$169,624.50	$168,074.50
Cost of energy improvement					$4,000.00
FHA mortgage insurance	$6,386.83	$6,414.81	$6,405.97	$6,445.73	$6,538.83
1 point origination fee	$1,680.75	$1,688.11	$1,685.78	$1,696.25	$1,720.75
Mortgage loan	$176,142.08	$176,913.67	$176,670.01	$177,766.48	$180,334.08
Embedded loan for improvement		$736.25	$503.75	$1,550.00	$4,000.00
Appraised home value	$208,180.00	$208,180.00	$208,180.00	$208,180.00	$212,180.00
Monthly P&I @ 9.5%	$1,481.10	$1,487.59	$1,485.54	$1,494.76	$1,516.35
Monthly taxes & insurance	$75.14	$75.14	$75.14	$75.14	$76.79
Monthly PITI*	$1,556.23	$1,562.72	$1,560.67	$1,569.89	$1,593.13
Monthly utilities	$78.93	$74.96	$77.47	$59.18	$50.87
Total monthly house payment	$1,635.16	$1,637.68	$1,638.14	$1,629.08	$1,644.01
Qualifying gross annual income	$64,395.85	$64,664.31	$64,579.54	$64,961.04	$63,725.34
Ratio (PITI* as % of income)	29%	29%	29%	29%	30%
Evaluation					
Additional annual income needed for loan		**$268.47**	**$183.69**	**$565.19**	**($670.51)**
% change in qualifying income		**0.4%**	**0.3%**	**0.9%**	**-1.0%**
Additional down payment		**$229.18**	**$156.81**	**$482.49**	**$83.84**
Additional PITI*		**$6.49**	**$4.44**	**$13.66**	**$36.90**

* Principal, interest, taxes, and insurance

Model IIIB: Ku'u Mea

Description: 3 bedrooms, 2 baths, $234,860 home

Financing: Conventional 30-year mortgage @ 10.125% with 20% down and 2 points

	Standard Water Heater	*High-Efficiency Gas Water Heater*	*High-Efficiency Electric Water Heater*	*Heat Pump Water Heater*	*Solar Water Heater*
Base home price	$234,860.00	$234,860.00	$234,860.00	$234,860.00	$234,860.00
Cost of energy improvement		$950.00	$650.00	$2,000.00	$4,000.00
Total price for home	$234,860.00	$235,810.00	$235,510.00	$236,860.00	$238,860.00
Down payment	$46,972.00	$47,162.00	$47,102.00	$47,372.00	$47,772.00
2 points paid by buyer	$3,757.76	$3,772.96	$3,768.16	$3,789.76	$3,821.76
Down payment + points	$50,729.76	$50,934.96	$50,870.16	$51,161.76	$51,593.76
Mortgage loan	$187,888.00	$188,648.00	$188,408.00	$189,488.00	$191,088.00
Embedded loan for improvement		$760.00	$520.00	$1,600.00	$3,200.00
Monthly P&I @ 10.125%	$1,666.23	$1,672.97	$1,670.85	$1,680.42	$1,694.61
Monthly taxes & insurance	$86.15	$86.15	$86.15	$86.15	$86.55
Monthly PITI*	$1,752.39	$1,759.13	$1,757.00	$1,766.58	$1,781.17
Monthly utilities	$78.93	$74.96	$77.47	$59.18	$50.87
Monthly PITI* + utilities	$1,831.32	$1,834.09	$1,834.46	$1,825.76	$1,832.04
Qualifying gross annual income	$75,102.30	$75,391.15	$75,299.93	$75,710.40	$76,335.67
Ratio (PITI as % of income)	28%	28%	28%	28%	28%
Evaluation					
Additional annual income needed for loan		**$288.85**	**$197.63**	**$608.11**	**$1,233.38**
% change in qualifying income		**0.4%**	**0.3%**	**0.8%**	**1.6%**
Additional down payment		**$205.20**	**$140.40**	**$432.00**	**$864.00**
Additional PITI*		**$6.74**	**$4.61**	**$14.19**	**$28.78**

* Principal, interest, taxes, and insurance

Model IIIC: Ku'u Waiwai

Description: 3 bedrooms, 2.5 baths, $247,980 home

Financing: Conventional 30-year mortgage @ 10.125% with 20% down and 2 points

	Standard Water Heater	*High Efficiency Gas Water Heater*	*High Efficiency Electric Water Heater*	*Heat Pump Water Heater*	*Solar Water Heater*
Base home price	$247,980.00	$247,980.00	$247,980.00	$247,980.00	$247,980.00
Cost of energy improvement		$950.00	$650.00	$2,000.00	$4,000.00
Total price for home	$247,980.00	$248,930.00	$248,630.00	$249,980.00	$251,980.00
Down payment	$49,596.00	$49,786.00	$49,726.00	$49,996.00	$50,396.00
2 points paid by buyer	$3,967.68	$3,982.88	$3,978.08	$3,999.68	$4,031.68
Down payment + points	$53,563.68	$53,768.88	$53,704.08	$53,995.68	$54,427.68
Mortgage loan	$198,384.00	$199,144.00	$198,904.00	$199,984.00	$201,584.00
Embedded loan for improvement		$760.00	$520.00	$1,600.00	$3,200.00
Monthly P&I @ 10.125%	$1,759.31	$1,766.05	$1,763.93	$1,773.50	$1,787.69
Monthly taxes & insurance	$91.57	$91.57	$91.57	$91.57	$91.97
Monthly PITI*	$1,850.89	$1,857.63	$1,855.50	$1,865.07	$1,879.66
Monthly utilities	$78.93	$74.96	$77.47	$59.18	$50.87
Monthly PITI* + utilities	$1,929.82	$1,932.59	$1,932.96	$1,924.26	$1,930.54
Qualifying gross annual income	$79,323.68	$79,612.53	$79,521.31	$79,931.78	$80,557.05
Ratio (PITI as % of income)	28%	28%	28%	28%	28%
Evaluation					
Additional annual income needed for loan		**$288.85**	**$197.63**	**$608.11**	**$1,233.38**
% change in qualifying income		**0.4%**	**0.2%**	**0.8%**	**1.6%**
Additional down payment		**$205.20**	**$140.40**	**$432.00**	**$864.00**
Additional PITI*		**$6.74**	**$4.61**	**$14.19**	**$28.78**

* Principal, interest, taxes, and insurance

Model IIID: Ku'u Makana

Description: 4 bedrooms, 2.5 baths, $264,600 home

Financing: Conventional 30-year mortgage @ 10.125% with 20% down and 2 points

	Standard Water Heater	*High-Efficiency Gas Water Heater*	*High-Efficiency Electric Water Heater*	*Heat Pump Water Heater*	*Solar Water Heater*
Base home price	$264,600.00	$264,600.00	$264,600.00	$264,600.00	$264,600.00
Cost of energy improvement		$950.00	$650.00	$2,000.00	$4,000.00
Total price for home	$264,600.00	$265,550.00	$265,250.00	$266,600.00	$268,600.00
Down payment	$52,920.00	$53,110.00	$53,050.00	$53,320.00	$53,720.00
2 points paid by buyer	$4,233.60	$4,248.80	$4,244.00	$4,265.60	$4,297.60
Down payment + points	$57,153.60	$57,358.80	$57,294.00	$57,585.60	$58,017.60
Mortgage loan	$211,680.00	$212,440.00	$212,200.00	$213,280.00	$214,880.00
Embedded loan for improvement		$760.00	$520.00	$1,600.00	$3,200.00
Monthly P&I @ 10.125%	$1,877.23	$1,883.97	$1,881.84	$1,891.42	$1,905.61
Monthly taxes & insurance	$98.43	$98.43	$98.43	$98.43	$98.83
Monthly PITI*	$1,975.66	$1,982.40	$1,980.27	$1,989.85	$2,004.44
Monthly utilities	$78.93	$74.96	$77.47	$59.18	$50.87
Monthly PITI* + utilities	$2,054.59	$2,057.36	$2,057.74	$2,049.03	$2,055.31
Qualifying gross annual income	$84,671.19	$84,960.04	$84,868.82	$85,279.29	$85,904.57
Ratio (PITI as % of income)	28%	28%	28%	28%	28%
Evaluation					
Additional annual income needed for loan		**$288.85**	**$197.63**	**$608.11**	**$1,233.38**
% change in qualifying income		**0.3%**	**0.2%**	**0.7%**	**1.5%**
Additional down payment		**$205.20**	**$140.40**	**$432.00**	**$864.00**
Additional PITI*		**$6.74**	**$4.61**	**$14.19**	**$28.78**

* Principal, interest, taxes, and insurance

Model IIIE: Ku'u 'Ohana

Description: 4 bedrooms, 2.5 baths, $279,307 home

Financing: Conventional 30-year mortgage @ 10.125% with 20% down and 2 points

	Standard Water Heater	*High Efficiency Gas Water Heater*	*High Efficiency Electric Water Heater*	*Heat Pump Water Heater*	*Solar Water Heater*
Base home price	$279,307.00	$279,307.00	$279,307.00	$279,307.00	$279,307.00
Cost of energy improvement		$950.00	$650.00	$2,000.00	$4,000.00
Total price for home	$279,307.00	$280,257.00	$279,957.00	$281,307.00	$283,307.00
Down payment	$55,861.40	$56,051.40	$55,991.40	$56,261.40	$56,661.40
2 points paid by buyer	$4,468.91	$4,484.11	$4,479.31	$4,500.91	$4,532.91
Down payment + points	$60,330.31	$60,535.51	$60,470.71	$60,762.31	$61,194.31
Mortgage loan	$223,445.60	$224,205.60	$223,965.60	$225,045.60	$226,645.60
Embedded loan for improvement		$760.00	$520.00	$1,600.00	$3,200.00
Monthly P&I @ 10.125%	$1,981.57	$1,988.31	$1,986.18	$1,995.76	$2,009.95
Monthly taxes & insurance	$104.51	$104.51	$104.51	$104.51	$104.91
Monthly PITI*	$2,086.07	$2,092.81	$2,090.69	$2,100.26	$2,114.85
Monthly utilities	$78.93	$74.96	$77.47	$59.18	$50.87
Monthly PITI* + utilities	$2,165.01	$2,167.78	$2,168.15	$2,159.45	$2,165.73
Qualifying gross annual income	$89,403.19	$89,692.04	$89,600.82	$90,011.30	$90,636.57
Ratio (PITI as % of income)	28%	28%	28%	28%	28%
Evaluation					
Additional annual income needed for loan		**$288.85**	**$197.63**	**$608.11**	**$1,233.38**
a % of total qualifying income?		**0.3%**	**0.2%**	**0.7%**	**1.4%**
Additional down payment		**$205.20**	**$140.40**	**$432.00**	**$864.00**
Additional PITI*		**$6.74**	**$4.61**	**$14.19**	**$28.78**

* Principal, interest, taxes, and insurance

Appendix D

Formulae for Computation of Financial Impacts

1. Impacts on Qualifying Income

NOTE: The following formulae are based on rules in effect from July, 1990 to June, 1991.

FHA/Hula-Mae Mortgage Loans for Affordable Homes

1. Total price for home = Base home price + Cost of energy improvement# + Closing costs

   # This term is included in the "total price for home" only if home has a high-efficiency gas or electric water heater or heat pump water heater.

2. Down payment = $750 + 0.05 * (Total price for home - $25,000)

3. Points paid by buyer = 0.01 * (Mortgage loan)

4. Base loan = 0.95 * (Total price for home - $25,000) + $24,250

5. Down payment and points = Down payment + Points paid by buyer

6. FHA mortgage insurance

   • Energy improvements other than solar hot water system

   FHA mortgage insurance = 0.038 * (Base loan)

   • Solar hot water systems

   FHA mortgage insurance = 0.038 * (Base loan + Cost of solar hot water system)

FHA/Hula-Mae Mortgage Loans for Affordable Homes (continued)

7. Mortgage loan = Base loan + Cost of energy improvement# + FHA mortgage insurance

   # This term is included in the "mortgage loan" only for homes with solar hot water systems.

8. Embedded loan for improvement

   • Energy improvements other than solar hot water system

   Embedded loan = 0.95 * (Cost of energy improvement)

   • Solar hot water system

   Embedded loan = Cost of solar hot water system

9. Appraised home value

   • Energy improvements other than solar hot water system

   Appraised home value = Base home price

   • Solar hot water system

   Appraised home value = Base home price + Cost of solar hot water system

FHA/Hula-Mae Mortgage Loans for Affordable Homes (continued)

10. Monthly principal and interest = (Conversion factor) * (Mortgage loan)

    The conversion factors are:

    0.00777790 for a mortgage interest rate of 8.625 percent per year.
    0.00840854 for a mortgage interest rate of 9.5 percent per year.

11. Monthly property taxes = [0.00409 * (Land value)] ÷ 12

    where:

    Land value = 0.8 * (Appraised home value)

    (NOTE: For affordable homes, the building value would at most be $24,800, which is 20 percent of the maximum appraised value of $124,000. After deducting the homeowner's tax exemption of $40,000, the building value falls to zero. Thus, no property taxes were computed on the building values of affordable homes.)

12. Monthly hazard insurance = 0.0002503 * (Building value)

    where:

    Building value = 0.2 * (Appraised home value)

13. Monthly PITI = Monthly principal and interest + Monthly property taxes + Monthly hazard insurance

FHA/Hula-Mae Mortgage Loans for Affordable Homes (continued)

14. Qualifying gross annual income = 12 * (Monthly PITI)/Qualifying ratio

where:

Qualifying ratio = 0.29 for high-efficiency gas and electric water heaters and heat pumps

Qualifying ratio = 0.30 for solar hot water system

Conventional Mortgage Loans for Market-Priced Homes

1. Total price for home = Base home price + Cost of energy improvement
2. Down payment = 0.2 * (Total price for home)
3. Points paid by buyer = 0.02 * Mortgage loan
4. Mortgage loan = 0.8 * (Total price for home)
5. Down payment and points = Down payment + Points paid by buyer
6. Embedded loan for improvement = 0.80 * (Cost of energy improvement)

Conventional Mortgage Loans for Market-Priced Homes (continued)

7. Appraised home value

   • Energy improvements other than solar hot water system

     Appraised home value = Base home price

   • Solar hot water system

     Appraised home value = Base home price + Cost of solar hot water system

8. Monthly principal and interest = Conversion factor * Mortgage loan

   The conversion factors are:

   0.00849989 for a mortgage interest rate of 9.625 percent per year
   0.00886823 for a mortgage interest rate of 10.125 percent per year

9. Monthly property taxes = [0.00409 * (Land value) + 0.00325 * (Building value - $40,000)] ÷ 12

   where:

   Land value = 0.6 * (Appraised home value)

   Building value = 0.4 * (Appraised home value)

10. Monthly hazard insurance = 0.0002503 * (Building value)

Conventional Mortgage Loans for Market-Priced Homes (continued)

11. Monthly PITI = Monthly principal and interest + Monthly property taxes + Monthly hazard insurance

12. Qualifying gross annual income = 12 * (Monthly PITI)/0.28

2. Pocketbook Impacts

Value of Tax Credit Plus Interest Less Taxes Thereon

1. Tax credit = (Tax credit percentage) * (Cost of energy improvement)

   where:

   Tax credit percentage equals 0.20 for heat pumps and 0.35 for solar systems

2. Interest on tax credit = (Tax credit) * $[(1 + i)^n - 1]$

   where:

   i = 0.0033333, i.e., the monthly rate of interest for an annual rate of 4%

   n = home ownership period in months - 8#

   # It is assumed that the tax credit is received 8 months after house purchase.

3. Value of tax credit plus interest less taxes thereon = Tax credit + (1 - Marginal tax rate) * (Interest on tax credit)

   where:

   Marginal tax rate = 0.25 for owners of affordable homes

   Marginal tax rate = 0.38 for owners of market-priced homes

Cumulative Savings on Monthly Utility Bills

1. Savings on monthly utility bill = Utility bill without improvement - Utility bill with improvement

2. Cumulative savings on monthly utility bills = (Savings on monthly utility bill) * $[(1 + i)^n - 1] \div i$

   where:

   i = 0.0033333, i.e., the monthly growth rate in savings on utility bills for an annual rate of 4%

   n = home ownership period in months

Increase in Down Payment Plus Foregone Interest Thereon

1. Additional down payment = Down payment with improvement - Down payment without improvement

2. Foregone interest = (Additional down payment) * $[(1 + i)^n - 1]$

   where:

   i = 0.0033333, i.e., the monthly rate of interest for an annual rate of 4%

   n = home ownership period in months

Increase in Down Payment Plus Foregone Interest Thereon (continued)

3. Increase in down payment + foregone interest thereon = Additional down payment + (1 - Marginal tax rate) * (Foregone interest)

where:

Marginal tax rate = 0.25 for owners of affordable homes

Marginal tax rate = 0.38 for owners of market-priced homes

Sum of Increased Mortgage Loan Payments Less Tax Savings

1. Additional monthly PITI = Monthly PITI with improvement - Monthly PITI without improvement

2. Additional monthly mortgage interest = (Annual mortgage interest rate ÷ 12) * (Mortgage loan with improvement - Mortgage loan without improvement)

Note: See Table 6 for annual mortgage interest rates.

3. Additional monthly property taxes = Property taxes with improvement - Property taxes without improvement

4. Additional monthly mortgage interest and property taxes = Additional monthly mortgage interest + Additional monthly property taxes

Sum of Increased Mortgage Loan Payments Less Tax Savings (continued)

5. Sum of increased mortgage loan payments less tax savings = n * [(Additional monthly PITI - (Marginal tax rate) * (Additional monthly mortgage interest and property taxes)]

where:

Marginal tax rate = 0.25 for owners of affordable homes

Marginal tax rate = 0.38 for owners of market-priced homes

n = Home ownership period in months

Maintenance and Repair Costs

Type of Improvement in Water Heating

Ownership Period	High-Efficiency Gas	High-Efficiency Electric	Heat Pump	Solar System
2 years	$0	$0	$0	$0
5 years	$125	$125	$275	$250

Total Net Savings for Pocketbook

	Value of tax credit plus interest less taxes thereon
+	Cumulative savings on monthly utility bills
-	Increase in down payment plus foregone interest thereon
-	Sum of increased mortgage loan payments less tax savings
-	Maintenance and repair costs
=	Total net savings for pocketbook

Appendix E

Pocketbook Impacts of Improvements in Energy Efficiency to Heat Water for Property Held Two Years

NOTE: The tables that follow present pocketbook impacts for four cases:

Case	Development Phase	Mortgage Rates	Utility Rates	Energy Consumption
A	1	higher	lower	lower
B	1	higher	lower	higher
C	2	lower	higher	lower
D	2	lower	higher	higher

In the last column of each table, the total net savings for the pocketbook were calculated as follows:

	Value of tax credit plus interest less taxes thereon
+	Cumulative savings on monthly utility bills
-	Increase in down payment plus foregone interest thereon
-	Sum of increased mortgage loan payments less tax savings
-	Maintenance and repair costs
=	Total net savings for pocketbook

For a given improvement in energy efficiency to heat water, note that the figures in the table are constant for all home prices for the cumulative savings on monthly utility bills and the maintenance and repair costs. For the other components that affect total net savings for the pocketbook, the figures vary across home prices for a given improvement. The after tax value of the tax credit plus interest varies because buyers of affordable homes are assumed to be in a lower marginal income tax bracket than buyers of market-priced homes. The increase in down payment and sum of increased mortgage payments vary for different home prices, primarily because of differences in mortgage financing requirements to puchase these homes and differences in tax brackets applicable to the foregone interest on the increase in down payment. See Chapter III for further details.

Table E-1. Pocketbook Impacts for Property Held Two Years under the Assumptions of Case A

High-Efficiency Gas Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$83	$60	$135	$0	($112)
$102	$0	$83	$60	$135	$0	($112)
$109	$0	$83	$60	$135	$0	($112)
$118	$0	$83	$60	$135	$0	($112)
$120	$0	$83	$60	$135	$0	($112)
$189	$0	$83	$158	$111	$0	($186)
$208	$0	$83	$241	$100	$0	($258)
$235	$0	$83	$216	$103	$0	($236)
$248	$0	$83	$216	$103	$0	($236)
$265	$0	$83	$216	$103	$0	($236)
$279	$0	$83	$216	$103	$0	($236)

High-Efficiency Electric Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$86	$41	$92	$0	($47)
$102	$0	$86	$41	$92	$0	($47)
$109	$0	$86	$41	$92	$0	($47)
$118	$0	$86	$41	$92	$0	($47)
$120	$0	$86	$41	$92	$0	($47)
$189	$0	$86	$108	$76	$0	($98)
$208	$0	$86	$165	$68	$0	($147)
$235	$0	$86	$148	$71	$0	($133)
$248	$0	$86	$148	$71	$0	($133)
$265	$0	$86	$148	$71	$0	($133)
$279	$0	$86	$148	$71	$0	($133)

Table E-1. Pocketbook Impacts for Property Held Two Years under the Assumptions of Case A (continued)

Heat Pump Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$416	$340	$127	$283	$0	$346
$102	$416	$340	$127	$283	$0	$346
$109	$416	$340	$127	$283	$0	$346
$118	$416	$340	$127	$283	$0	$346
$120	$416	$340	$127	$283	$0	$346
$189	$414	$340	$332	$234	$0	$188
$208	$414	$340	$507	$211	$0	$36
$235	$414	$340	$454	$217	$0	$83
$248	$414	$340	$454	$217	$0	$83
$265	$414	$340	$454	$217	$0	$83
$279	$414	$340	$454	$217	$0	$83

Solar Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$1,457	$456	$44	$621	$0	$1,248
$102	$1,457	$456	$44	$621	$0	$1,248
$109	$1,457	$456	$44	$621	$0	$1,248
$118	$1,457	$456	$44	$621	$0	$1,248
$120	$1,457	$456	$44	$621	$0	$1,248
$189	$1,447	$456	$88	$571	$0	$1,244
$208	$1,447	$456	$88	$571	$0	$1,244
$235	$1,447	$456	$909	$433	$0	$561
$248	$1,447	$456	$909	$433	$0	$561
$265	$1,447	$456	$909	$433	$0	$561
$279	$1,447	$456	$909	$433	$0	$561

Table E-2. Pocketbook Impacts for Property Held Two Yea under the Assumptions of Case B

High-Efficiency Gas Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$99	$60	$135	$0	($96)
$102	$0	$99	$60	$135	$0	($96)
$109	$0	$99	$60	$135	$0	($96)
$118	$0	$99	$60	$135	$0	($96)
$120	$0	$99	$60	$135	$0	($96)
$189	$0	$99	$158	$111	$0	($170)
$208	$0	$99	$241	$100	$0	($242)
$235	$0	$99	$216	$103	$0	($220)
$248	$0	$99	$216	$103	$0	($220)
$265	$0	$99	$216	$103	$0	($220)
$279	$0	$99	$216	$103	$0	($220)

High-Efficiency Electric Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$36	$41	$92	$0	($97)
$102	$0	$36	$41	$92	$0	($97)
$109	$0	$36	$41	$92	$0	($97)
$118	$0	$36	$41	$92	$0	($97)
$120	$0	$36	$41	$92	$0	($97)
$189	$0	$36	$108	$76	$0	($148)
$208	$0	$36	$165	$68	$0	($197)
$235	$0	$36	$148	$71	$0	($183)
$248	$0	$36	$148	$71	$0	($183)
$265	$0	$36	$148	$71	$0	($183)
$279	$0	$36	$148	$71	$0	($183)

Table E-2. Pocketbook Impacts for Property Held Two Year under the Assumptions of Case B (continued)

Heat Pump Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$416	$493	$127	$283	$0	$499
$102	$416	$493	$127	$283	$0	$499
$109	$416	$493	$127	$283	$0	$499
$118	$416	$493	$127	$283	$0	$499
$120	$416	$493	$127	$283	$0	$499
$189	$414	$493	$332	$234	$0	$341
$208	$414	$493	$507	$211	$0	$189
$235	$414	$493	$454	$217	$0	$236
$248	$414	$493	$454	$217	$0	$236
$265	$414	$493	$454	$217	$0	$236
$279	$414	$493	$454	$217	$0	$236

Solar Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$1,457	$700	$44	$621	$0	$1,492
$102	$1,457	$700	$44	$621	$0	$1,492
$109	$1,457	$700	$44	$624	$0	$1,492
$118	$1,457	$700	$44	$621	$0	$1,492
$120	$1,457	$700	$44	$621	$0	$1,492
$189	$1,447	$700	$88	$571	$0	$1,488
$208	$1,447	$700	$88	$571	$0	$1,488
$235	$1,447	$700	$909	$433	$0	$805
$248	$1,447	$700	$909	$433	$0	$805
$265	$1,447	$700	$909	$433	$0	$805
$279	$1,447	$700	$909	$433	$0	$805

Table E-3. Pocketbook Impacts for Property Held Two Years under the Assumptions of Case C

High-Efficiency Gas Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$94	$60	$135	$0	($101)
$102	$0	$94	$60	$135	$0	($101)
$109	$0	$94	$60	$135	$0	($101)
$118	$0	$94	$60	$135	$0	($101)
$120	$0	$94	$60	$135	$0	($101)
$265	$0	$94	$216	$99	$0	($221)
$279	$0	$94	$216	$99	$0	($221)
$297	$0	$94	$216	$99	$0	($221)
$317	$0	$94	$216	$99	$0	($221)
$333	$0	$94	$216	$99	$0	($221)
$340	$0	$94	$216	$99	$0	($221)

High-Efficiency Electric Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$120	$41	$92	$0	($13)
$102	$0	$120	$41	$92	$0	($13)
$109	$0	$120	$41	$92	$0	($13)
$118	$0	$120	$41	$92	$0	($13)
$120	$0	$120	$41	$92	$0	($13)
$265	$0	$120	$148	$68	$0	($96)
$279	$0	$120	$148	$68	$0	($96)
$297	$0	$120	$148	$68	$0	($96)
$317	$0	$120	$148	$68	$0	($96)
$333	$0	$120	$148	$68	$0	($96)
$340	$0	$120	$148	$68	$0	($96)

Table E-3. Pocketbook Impacts for Property Held Two Years under the Assumptions of Case C (continued)

Heat Pump Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$416	$384	$127	$283	$0	$392
$102	$416	$384	$127	$283	$0	$392
$109	$416	$384	$127	$283	$0	$392
$118	$416	$384	$127	$283	$0	$392
$120	$416	$384	$127	$283	$0	$392
$265	$414	$384	$454	$209	$0	$134
$279	$414	$384	$454	$209	$0	$134
$297	$414	$384	$454	$209	$0	$134
$317	$414	$384	$454	$209	$0	$134
$333	$414	$384	$454	$209	$0	$134
$340	$414	$384	$454	$209	$0	$134

Solar Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$1,457	$504	$44	$621	$0	$1,296
$102	$1,457	$504	$44	$621	$0	$1,296
$109	$1,457	$504	$44	$621	$0	$1,296
$118	$1,457	$504	$44	$621	$0	$1,296
$120	$1,457	$504	$44	$621	$0	$1,296
$265	$1,447	$504	$909	$416	$0	$626
$279	$1,447	$504	$909	$416	$0	$626
$297	$1,447	$504	$909	$416	$0	$626
$317	$1,447	$504	$909	$416	$0	$626
$333	$1,447	$504	$909	$416	$0	$626
$340	$1,447	$504	$909	$416	$0	$626

Table E-4. Pocketbook Impacts for Property Held Two Year under the Assumptions of Case D

High-Efficiency Gas Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$111	$60	$135	$0	($84)
$102	$0	$111	$60	$135	$0	($84)
$109	$0	$111	$60	$135	$0	($84)
$118	$0	$111	$60	$135	$0	($84)
$120	$0	$111	$60	$135	$0	($84)
$265	$0	$111	$216	$99	$0	($204)
$279	$0	$111	$216	$99	$0	($204)
$297	$0	$111	$216	$99	$0	($204)
$317	$0	$111	$216	$99	$0	($204)
$333	$0	$111	$216	$99	$0	($204)
$340	$0	$111	$216	$99	$0	($204)

High-Efficiency Electric Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$95	$41	$92	$0	($38)
$102	$0	$95	$41	$92	$0	($38)
$109	$0	$95	$41	$92	$0	($38)
$118	$0	$95	$41	$92	$0	($38)
$120	$0	$95	$41	$92	$0	($38)
$265	$0	$95	$148	$68	$0	($121)
$279	$0	$95	$148	$68	$0	($121)
$297	$0	$95	$148	$68	$0	($121)
$317	$0	$95	$148	$68	$0	($121)
$333	$0	$95	$148	$68	$0	($121)
$340	$0	$95	$148	$68	$0	($121)

Table E-4. Pocketbook Impacts for Property Held Two Yea under the Assumptions of Case D (continued)

Heat Pump Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$416	$569	$127	$283	$0	$575
$102	$416	$569	$127	$283	$0	$575
$109	$416	$569	$127	$283	$0	$575
$118	$416	$569	$127	$283	$0	$575
$120	$416	$569	$127	$283	$0	$575
$265	$414	$569	$454	$209	$0	$320
$279	$414	$569	$454	$209	$0	$320
$297	$414	$569	$454	$209	$0	$320
$317	$414	$569	$454	$209	$0	$320
$333	$414	$569	$454	$209	$0	$320
$340	$414	$569	$454	$209	$0	$320

Solar Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$1,457	$785	$44	$621	$0	$1,577
$102	$1,457	$785	$44	$621	$0	$1,577
$109	$1,457	$785	$44	$621	$0	$1,577
$118	$1,457	$785	$44	$621	$0	$1,577
$120	$1,457	$785	$44	$621	$0	$1,577
$265	$1,447	$785	$909	$416	$0	$907
$279	$1,447	$785	$909	$416	$0	$907
$297	$1,447	$785	$909	$416	$0	$907
$317	$1,447	$785	$909	$416	$0	$907
$333	$1,447	$785	$909	$416	$0	$907
$340	$1,447	$785	$909	$416	$0	$907

Appendix F

Pocketbook Impacts of Improvements in Energy Efficiency to Heat Water for Property Held Five Years

NOTE: The tables that follow present pocketbook impacts for four cases:

Case	Development Phase	Mortgage Rates	Utility Rates	Energy Consumption
A	1	higher	lower	lower
B	1	higher	lower	higher
C	2	lower	higher	lower
D	2	lower	higher	higher

In the last column of each table, the total net savings for the pocketbook were calculated as follows:

	Value of tax credit plus interest less taxes thereon
+	Cumulative savings on monthly utility bills
-	Increase in down payment plus foregone interest thereon
-	Sum of increased mortgage loan payments less tax savings
-	Maintenance and repair costs
=	Total net savings for pocketbook

For a given improvement in energy efficiency to heat water, note that the figures in the table are constant for all home prices for the cumulative savings on monthly utility bills and the maintenance and repair costs. For the other components that affect total net savings for the pocketbook, the figures vary across home prices for a given improvement. The after tax value of the tax credit plus interest varies because buyers of affordable homes are assumed to be in a lower marginal income tax bracket than buyers of market-priced homes. The increase in down payment and sum of increased mortgage payments vary for different home prices, primarily because of differences in mortgage financing requirements to puchase these homes and differences in tax brackets applicable to the foregone interest on the increase in down payment. See Chapter III for further details.

Table F-1. Pocketbook Impacts for Property Held Five Years under the Assumptions of Case A

High-Efficiency Gas Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$221	$66	$336	$125	($306)
$102	$0	$221	$66	$336	$125	($306)
$109	$0	$221	$66	$336	$125	($306)
$118	$0	$221	$66	$336	$125	($306)
$120	$0	$221	$66	$336	$125	($306)
$189	$0	$221	$171	$277	$125	($352)
$208	$0	$221	$261	$250	$125	($415)
$235	$0	$221	$233	$258	$125	($395)
$248	$0	$221	$233	$258	$125	($395)
$265	$0	$221	$233	$258	$125	($395)
$279	$0	$221	$233	$258	$125	($395)

High-Efficiency Electric Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$229	$45	$230	$125	($171)
$102	$0	$229	$45	$230	$125	($171)
$109	$0	$229	$45	$230	$125	($171)
$118	$0	$229	$45	$230	$125	($171)
$120	$0	$229	$45	$230	$125	($171)
$189	$0	$229	$117	$190	$125	($203)
$208	$0	$229	$178	$171	$125	($245)
$235	$0	$229	$160	$177	$125	($233)
$248	$0	$229	$160	$177	$125	($233)
$265	$0	$229	$160	$177	$125	($233)
$279	$0	$229	$160	$177	$125	($233)

Table F-1. Pocketbook Impacts for Property Held Five Year under the Assumptions of Case A (continued)

Heat Pump Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$457	$905	$140	$708	$275	$239
$102	$457	$905	$140	$708	$275	$239
$109	$457	$905	$140	$708	$275	$239
$118	$457	$905	$140	$708	$275	$239
$120	$457	$905	$140	$708	$275	$239
$189	$447	$905	$359	$584	$275	$134
$208	$447	$905	$549	$526	$275	$2
$235	$447	$905	$491	$544	$275	$42
$248	$447	$905	$491	$544	$275	$42
$265	$447	$905	$491	$544	$275	$42
$279	$447	$905	$491	$544	$275	$42

Solar Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$1,598	$1,212	$48	$1,551	$250	$961
$102	$1,598	$1,212	$48	$1,551	$250	$961
$109	$1,598	$1,212	$48	$1,551	$250	$961
$118	$1,598	$1,212	$48	$1,551	$250	$961
$120	$1,598	$1,212	$48	$1,551	$250	$961
$189	$1,564	$1,212	$95	$1,427	$250	$1,004
$208	$1,564	$1,212	$95	$1,427	$250	$1,004
$235	$1,564	$1,212	$982	$1,081	$250	$463
$248	$1,564	$1,212	$982	$1,081	$250	$463
$265	$1,564	$1,212	$982	$1,081	$250	$463
$279	$1,564	$1,212	$982	$1,081	$250	$463

Table F-2. Pocketbook Impacts for Property Held Five Years under the Assumptions of Case B

High-Efficiency Gas Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$263	$66	$336	$125	($264)
$102	$0	$263	$66	$336	$125	($264)
$109	$0	$263	$66	$336	$125	($264)
$118	$0	$263	$66	$336	$125	($264)
$120	$0	$263	$66	$336	$125	($264)
$189	$0	$263	$171	$277	$125	($310)
$208	$0	$263	$261	$250	$125	($373)
$235	$0	$263	$233	$258	$125	($353)
$248	$0	$263	$233	$258	$125	($353)
$265	$0	$263	$233	$258	$125	($353)
$279	$0	$263	$233	$258	$125	($353)

High-Efficiency Electric Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$97	$45	$230	$125	($303)
$102	$0	$97	$45	$230	$125	($303)
$109	$0	$97	$45	$230	$125	($303)
$118	$0	$97	$45	$230	$125	($303)
$120	$0	$97	$45	$230	$125	($303)
$189	$0	$97	$117	$190	$125	($335)
$208	$0	$97	$178	$171	$125	($377)
$235	$0	$97	$160	$177	$125	($365)
$248	$0	$97	$160	$177	$125	($365)
$265	$0	$97	$160	$177	$125	($365)
$279	$0	$97	$160	$177	$125	($365)

Table F-2. Pocketbook Impacts for Property Held Five Years under the Assumptions of Case B (continued)

Heat Pump Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$457	$1,309	$140	$708	$275	$643
$102	$457	$1,309	$140	$708	$275	$643
$109	$457	$1,309	$140	$708	$275	$643
$118	$457	$1,309	$140	$708	$275	$643
$120	$457	$1,309	$140	$708	$275	$643
$189	$447	$1,309	$359	$584	$275	$538
$208	$447	$1,309	$549	$526	$275	$406
$235	$447	$1,309	$491	$544	$275	$446
$248	$447	$1,309	$491	$544	$275	$446
$265	$447	$1,309	$491	$544	$275	$446
$279	$447	$1,309	$491	$544	$275	$446

Solar Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$1,598	$1,860	$48	$1,551	$250	$1,609
$102	$1,598	$1,860	$48	$1,551	$250	$1,609
$109	$1,598	$1,860	$48	$1,551	$250	$1,609
$118	$1,598	$1,860	$48	$1,551	$250	$1,609
$120	$1,598	$1,860	$48	$1,551	$250	$1,609
$189	$1,564	$1,860	$95	$1,427	$250	$1,652
$208	$1,564	$1,860	$95	$1,427	$250	$1,652
$235	$1,564	$1,860	$982	$1,081	$250	$1,111
$248	$1,564	$1,860	$982	$1,081	$250	$1,111
$265	$1,564	$1,860	$982	$1,081	$250	$1,111
$279	$1,564	$1,860	$982	$1,081	$250	$1,111

Table F-3. Pocketbook Impacts for Property Held Five Year under the Assumptions of Case C

High-Efficiency Gas Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$249	$66	$336	$125	($278)
$102	$0	$249	$66	$336	$125	($278)
$109	$0	$249	$66	$336	$125	($278)
$118	$0	$249	$66	$336	$125	($278)
$120	$0	$249	$66	$336	$125	($278)
$265	$0	$249	$233	$249	$125	($358)
$279	$0	$249	$233	$249	$125	($358)
$297	$0	$249	$233	$249	$125	($358)
$317	$0	$249	$233	$249	$125	($358)
$333	$0	$249	$233	$249	$125	($358)
$340	$0	$249	$233	$249	$125	($358)

High-Efficiency Electric Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$319	$45	$230	$125	($81)
$102	$0	$319	$45	$230	$125	($81)
$109	$0	$319	$45	$230	$125	($81)
$118	$0	$319	$45	$230	$125	($81)
$120	$0	$319	$45	$230	$125	($81)
$265	$0	$319	$160	$170	$125	($136)
$279	$0	$319	$160	$170	$125	($136)
$297	$0	$319	$160	$170	$125	($136)
$317	$0	$319	$160	$170	$125	($136)
$333	$0	$319	$160	$170	$125	($136)
$340	$0	$319	$160	$170	$125	($136)

Table F-3. Pocketbook Impacts for Property Held Five Years under the Assumptions of Case C (continued)

Heat Pump Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$457	$1,022	$140	$708	$275	$356
$102	$457	$1,022	$140	$708	$275	$356
$109	$457	$1,022	$140	$708	$275	$356
$118	$457	$1,022	$140	$708	$275	$356
$120	$457	$1,022	$140	$708	$275	$356
$265	$447	$1,022	$491	$523	$275	$180
$279	$447	$1,022	$491	$523	$275	$180
$297	$447	$1,022	$491	$523	$275	$180
$317	$447	$1,022	$491	$523	$275	$180
$333	$447	$1,022	$491	$523	$275	$180
$340	$447	$1,022	$491	$523	$275	$180

Solar Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$1,598	$1,341	$48	$1,551	$250	$1,090
$102	$1,598	$1,341	$48	$1,551	$250	$1,090
$109	$1,598	$1,341	$48	$1,551	$250	$1,090
$118	$1,598	$1,341	$48	$1,551	$250	$1,090
$120	$1,598	$1,341	$48	$1,551	$250	$1,090
$265	$1,564	$1,341	$982	$1,041	$250	$632
$279	$1,564	$1,341	$982	$1,041	$250	$632
$297	$1,564	$1,341	$982	$1,041	$250	$632
$317	$1,564	$1,341	$982	$1,041	$250	$632
$333	$1,564	$1,341	$982	$1,041	$250	$632
$340	$1,564	$1,341	$982	$1,041	$250	$632

Table F-4. Pocketbook Impacts for Property Held Five Years under the Assumptions of Case D

High-Efficiency Gas Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$296	$66	$336	$125	($231)
$102	$0	$296	$66	$336	$125	($231)
$109	$0	$296	$66	$336	$125	($231)
$118	$0	$296	$66	$336	$125	($231)
$120	$0	$296	$66	$336	$125	($231)
$265	$0	$296	$233	$249	$125	($311)
$279	$0	$296	$233	$249	$125	($311)
$297	$0	$296	$233	$249	$125	($311)
$317	$0	$296	$233	$249	$125	($311)
$333	$0	$296	$233	$249	$125	($311)
$340	$0	$296	$233	$249	$125	($311)

High-Efficiency Electric Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$0	$252	$45	$230	$125	($148)
$102	$0	$252	$45	$230	$125	($148)
$109	$0	$252	$45	$230	$125	($148)
$118	$0	$252	$45	$230	$125	($148)
$120	$0	$252	$45	$230	$125	($148)
$265	$0	$252	$160	$170	$125	($203)
$279	$0	$252	$160	$170	$125	($203)
$297	$0	$252	$160	$170	$125	($203)
$317	$0	$252	$160	$170	$125	($203)
$333	$0	$252	$160	$170	$125	($203)
$340	$0	$252	$160	$170	$125	($203)

Table F-4. Pocketbook Impacts for Property Held Five Year under the Assumptions of Case D (continued)

Heat Pump Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$457	$1,514	$140	$708	$275	$848
$102	$457	$1,514	$140	$708	$275	$848
$109	$457	$1,514	$140	$708	$275	$848
$118	$457	$1,514	$140	$708	$275	$848
$120	$457	$1,514	$140	$708	$275	$848
$265	$447	$1,514	$491	$523	$275	$672
$279	$447	$1,514	$491	$523	$275	$672
$297	$447	$1,514	$491	$523	$275	$672
$317	$447	$1,514	$491	$523	$275	$672
$333	$447	$1,514	$491	$523	$275	$672
$340	$447	$1,514	$491	$523	$275	$672

Solar Water Heater

Average home price (1,000)	Value of tax credit plus interest less taxes thereon	Cumulative savings on monthly utility bills	Increase in down payment plus foregone interest thereon	Sum of increased mortgage loan payments less tax savings	Maintenance and repair costs	Total net savings for pocketbook
$96	$1,598	$2,087	$48	$1,551	$250	$1,836
$102	$1,598	$2,087	$48	$1,551	$250	$1,836
$109	$1,598	$2,087	$48	$1,551	$250	$1,836
$118	$1,598	$2,087	$48	$1,551	$250	$1,836
$120	$1,598	$2,087	$48	$1,551	$250	$1,836
$265	$1,564	$2,087	$982	$1,041	$250	$1,378
$279	$1,564	$2,087	$982	$1,041	$250	$1,378
$297	$1,564	$2,087	$982	$1,041	$250	$1,378
$317	$1,564	$2,087	$982	$1,041	$250	$1,378
$333	$1,564	$2,087	$982	$1,041	$250	$1,378
$340	$1,564	$2,087	$982	$1,041	$250	$1,378